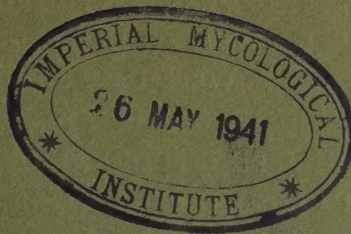
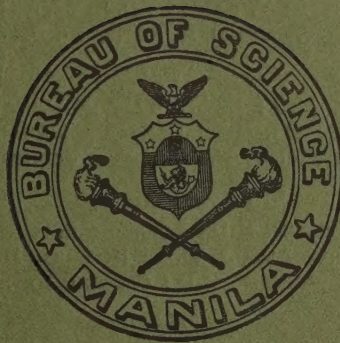


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NEW OR LITTLE-KNOWN TIPULIDÆ FROM EASTERN ASIA (DIPTERA), XLIII

By CHARLES P. ALEXANDER
Of Amherst, Massachusetts

FIVE PLATES

The crane flies discussed at this time are virtually all from China, most of them being included in a collection made by a German collector, Herr Klapperich, in the highest mountains of western Fukien. This important series was sent to me by Dr. Ernst Cremer, of the Zoologisches Forschungsinstitut und Museum Alexander Koenig, Reichsinstitut, Bonn, Germany, where the types and uniques of the included species are preserved. One of the stations in Fukien is indicated as having an altitude up to 3,000 meters (9,750 feet), which is greater than any indicated on the maps of the National Geographic Society or in Goode's "School Atlas", 1925, for this region. My friend and former co-worker, Professor Claude Kellog, for many years resident in Foochow, Fukien Province, informs me that it is his belief that such high altitudes actually occur in western Fukien. Certain of the flies taken at this station, notably the subgenus *Pedicia* Latreille, add to the impression of an unusually high altitude at this particular latitude. Other important material from China is from Mount Omei, Szechwan, where it was collected by Mr. Tsen, through the continued friendly interest of the Reverend Mr. George M. Franck, and by the native collectors of the Reverend David C. Graham, the latter material being preserved in the United States National Museum. Still further Chinese material was kindly presented to me by Mr. Gaines Liu, collected in Szechwan and Anhwei. A number of records of little-

known Japanese species are given. A few additional species are from other sources that have been indicated in the text. Unless otherwise stated, all types are preserved in my private collection of these flies.

TIPULINÆ

PSELLIOPHORA SCURRA sp. nov. Plate 1, fig. 1; Plate 2, fig. 25.

General coloration yellow; mesonotal præscutum with three conspicuous, dark-brown stripes; antennæ with branches of flagellum (male) relatively short; posterior tibiæ with a broad, whitish ring beyond base; wings yellow, handsomely patterned with brown, cells C and Sc yellow; abdominal segments yellow, lateral and posterior borders of segments restrictedly darkened; outer segments uniformly black; male hypopygium with caudal margin of tergite with a small median lobe; outer dististyle with margin deeply incised; eighth sternite with a depressed-flat-tened median lobe.

Male.—Length, about 16 millimeters; wing, 15; antennæ, about 7.

Female.—Length, about 20 to 21 millimeters; wing, 16 to 17; antennæ, about 2.5.

Frontal prolongation of head yellow, very high, in virtual alignment with vertex; nasus stout; palpi obscure yellow, terminal segment at tip passing into dark brown. Antennæ (male) relatively long; basal three segments obscure yellow, succeeding segments bicolored, base and branches brown, outer end of stem yellow; outer flagellar segments uniformly darkened; branch of first flagellar segment relatively long and pointed; succeeding branches relatively short, as compared with *scalator*, the longest from two to two and one-half times the segments, provided with long, erect, white pubescence. Head yellow, vertex except medially with abundant, dark setæ.

Pronotum yellow. Mesonotal præscutum yellow, with three dark-brown stripes; scutum yellow, each lobe with two conspicuous dark-brown areas that are posterior prolongations of the lateral præscutal stripes; scutellum yellow; postnotum yellow. Pleura yellow. Halteres yellow, base of knob more infuscated. Legs with coxæ and trochanters yellow; fore- and middle legs reddish yellow, tarsal segments darker; posterior femora reddish yellow, tips very narrowly blackened; tibiæ brown with a broad, whitish ring immediately beyond base; tarsi brown. Wings

(Plate 1, fig. 1) deep yellow, handsomely patterned with brown, the latter including wing tip; a narrowly interrupted band at level of origin of Rs, widened behind in cells Cu and 1st A; posterior border of wing in cell 2d A darkened; basal portions of cells included in the darkened wing tip with small yellow, central spots, these involving cells R_2 to M_3 , inclusive; cells C and Sc yellow; veins brown, yellow on basal third of wing and in costal region; obliterative areas relatively restricted, white. Venation: Rs rather commonly spurred at origin; cell M_1 broadly sessile; cell 2d A wide.

Abdomen with basal segments yellow, caudal margins narrowly, lateral borders somewhat more extensively blackened; terminal segments in both sexes black. Ovipositor with cerci slender, straight. Male hypopygium with tergite (Plate 2, fig. 25, 9t) blackened, margin emarginate, with a low, median lobule in notch; lateral lobes subtruncate. Outer dististyle, *od*, black, sinuous at base, margin deeply incised, as shown; inner dististyle, *id*, long and relatively narrow, black, beak slender; below beak a smaller, blackened spine. Margin of ninth sternite with brushes of very long yellow setæ. Gonapophyses, *g*, appearing as blackened spikes, slender, straight, apex slightly decurved. Eighth sternite, *8s*, with caudal margin prolonged into a flattened-depressed, median lobe that is about one and one-half as long as broad, very densely provided with long yellow setæ.

Habitat.—China (Fukien).

Holotype, male, Kuatun, altitude 2,500 to 3,000 meters, May 29, 1938 (*Klapperich*). Allotopotype, female, June 15, 1938. Paratopotypes, 2 females, June 13 to 17, 1938.

The nearest relative of the present fly seems to be *Pselliophora scalator* Alexander, which, while generally similar, has the pattern of the wings and abdomen different, the antennal branches longer, and the structure of the male hypopygium distinct.

TANYPTERA SUBCOGNATA sp. nov. Plate 1, fig. 2; Plate 2, fig. 26.

General coloration of mesonotal præscutum obscure brownish yellow, disc almost covered by three confluent, polished, black stripes; flagellar branches black, relatively elongate; halteres uniformly pale yellow throughout; wings with a strong brownish-yellow suffusion, stigma and a narrow seam along cord darker brown; Rs long and straight; R_3 long, straight, approximately three times as long as R_{1+2} ; cell M_1 long-petiolate; cell 1st M_2

small; abdominal tergites obscure yellow, trivittate with black, median stripe continuous; inner dististyle of male hypopygium acutely pointed at apex.

Male.—Length, about 14 millimeters; wing, 14, antennæ, about 4.

Frontal prolongation of head dull black; palpi black. Antennæ black throughout; outer branch of first flagellar segment longer and slenderer than basal tubercle; paired branches of segments relatively slender, about two and one-half times as long as simple outer branch. Head dull black.

Pronotum black, yellow behind. Mesonotal præscutum with ground color restricted, obscure brownish yellow, humeral region clearer yellow, disc chiefly covered by three confluent, polished, black stripes, region of usual interspaces with a row of transverse impressions; posterior sclerites of notum polished black, posterior portion of mid area of scutum and mediotergite sparsely pruinose; parascutella paler. Pleura variegated obscure yellow and dark, surface more or less pruinose; obscure, brownish-yellow areas on dorsal sternopleurite, clear yellow on ventral pleurotergite; dorsopleural membrane buffy yellow. Halteres uniformly pale yellow. Legs with coxæ black, sparsely pruinose; trochanters brownish yellow; all legs broken beyond one-third length of femora, this portion obscure brownish yellow, passing into black. Wings (Plate 1, fig. 2) with a strong brownish-yellow suffusion, prearcular and costal portions clearer yellow; stigma medium brown, nearly concolorous with a narrow brown seam on cord; veins dark brown, paler in brightened areas. Venation: Rs long and straight, about twice m-cu; R_{1+2} oblique, about one-third length of long, straight R_3 ; cell M_1 only a little longer than its petiole; cell 1st M_2 small.

Abdomen with tergites obscure yellow, with a broad, continuous, median black stripe, and narrower, sublateral vittæ that are broken on the basal rings of segments, lacking on first segment and basal half of second; lateral margins of tergites pale; outer segments, including moderate-sized hypopygium, polished black. Male hypopygium with outer dististyle (Plate 2, fig. 26, *od*) a black, ear-shaped blade, narrowed to subacute apex, surface with microscopic punctures, including a group of about six or seven larger punctures on upper portion. Inner dististyle, *id*, strongly curved, heavily blackened, at apex suddenly narrowed into a long, straight spine; surface of style, especially near apical spine, with long, yellow setæ.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Yien Lao Dong, altitude 6,500 feet, August 5, 1935 (*Graham*).

The most similar described species is *Tanyptera cognata* Alexander, likewise from western China, which differs in the coloration of the body and halteres and in the wing venation, especially the more arcuated R_s and R_3 .

TANYPTERA ANTICA ANTICOIDES subsp. nov.

Female.—Length, about 17 millimeters; wing, 11.5; antennæ, about 2.9 mm.

Head and thorax dull black, the latter more or less roughened and alutaceous. Antennæ (female) black throughout, 13-segmented; first flagellar segment a very little longer than second; succeeding segments gradually decreasing in length but becoming more convex on ventral face; terminal segment abruptly reduced, about one-fourth size of penultimate but of approximately similar shape. Legs about as in the typical form; white ring of foretibia very broad, including about one-half of total length of segment; posterior tibia uniformly pale brown, distal half not differentiated in color from base. Wings with a brownish-yellow tinge; outer radial field except at apex, together with adjacent portions of cells M_1 , 1st M_2 , and 2d M_2 conspicuously dark brown; veins yellowish brown to pale brown. Venation: R_s long and more nearly straight than in typical *antica*, exceeding three times length of m-cu; r-m reduced to a point by approximation of veins R_{4+5} and M_{1+2} ; cell 1st M_2 about one and one-half as long as wide. Abdomen black, with a subbasal and a subterminal reddish ring. Ovipositor with cerci unusually broad and compressed, hypovalvæ slenderer.

Habitat.—China (Fukien).

Holotype, female, Kuatun, altitude 2,500 to 3,000 meters, May 23, 1938 (*Klapperich*).

DICTENIDIA STALACTITICA sp. nov. Plate 1, fig. 3; Plate 2, figs. 27 to 30.

General coloration of mesonotum black, præscutum yellow with three black stripes; antennæ elongate, about one-half length of body, flagellar branches long and slender; posterior tibiæ brown, with a narrow, yellowish-white, subbasal ring; wing subhyaline, with a relatively heavy brown pattern; no macrotrichia in cells of wing; male hypopygium with outer dististyle unusually long and attenuated; inner dististyle with beak produced into a lobe or flange on lower face.

Male.—Length, about 14 millimeters; wing, 12.5; antennæ, about 7.

Frontal prolongation of head short, obscure yellow, blackened above, provided with abundant black setæ; palpi black. Antennæ (Plate 2, fig. 27) elongate; scape brown, remainder of organ black with only distal ends of flagellar segments somewhat paler; branches of flagellum unusually long, basal branch longer and somewhat stouter than outer branch, at and before apex with conspicuous setæ; branch of first flagellar segment nearly twice as long as segment, without setæ; terminal segment elongate, simple, a little shorter than apical branch of penultimate segment. Head dark brown, polished; anterior vertex broad, about twice diameter of scape.

Pronotum obscure yellow, darker laterally. Mesonotal præscutum with surface dull or only feebly shiny, obscure yellow, with three black stripes; scutum and scutellum uniformly blackened, parascutella a little paler; mediotergite blackened, pleurotergite paler. Pleura obscure yellow, variegated with darker; dorsopleural membrane buffy yellow. Halteres with stem obscure yellow, knob dark brown. Legs with coxæ brownish yellow; trochanters obscure yellow; femora brownish yellow, tip blackened, preceded by a very vague, clearer yellow, subterminal ring; tibiæ brown, posterior pair with a narrow yellowish-white, subbasal ring that is a little wider than darkened base; tarsi black. Wings (Plate 1, fig. 3) subhyaline, with a relatively heavy brown pattern, as follows: Postarcular in basal fourth of cell R; origin of Rs; along anterior cord and as a broad apex in cells R_2 to $2d\ M_2$, inclusive; posterior cord more narrowly seamed; prearcular field and basal half of cell C more yellowish; veins dark brown. No macrotrichia in cells of wing. Venation: petiole of cell M_1 shorter than m.

Abdomen obscure yellow, tergites with a conspicuous, median, black stripe, areas of individual segments widened behind; lateral stripes poorly indicated; sternites extensively darkened on posterior portions; terminal segments, including hypopygium, black. Male hypopygium (Plate 2, fig. 28) with outer dististyle (Plate 2, fig. 29, *od*) geniculate, distal portion about twice as long as elongate, slender base, swollen on posterior third. Inner dististyle, *id*, with crest high, beak with a conspicuous lobe or flange on lower margin. Gonapophysis, *g*, slender, gently curved, surface with numerous appressed setæ.

In *Dictenidia glabrata* (Plate 2, fig. 30) the outer dististyle, *od*, is much shorter, from a shortened base. Inner dististyle, *id*, with beak slender and without flange. Gonapophysis, *g*, shorter.

Habitat.—China (Fukien).

Holotype, male, Kuatun, altitude 2,500 to 3,000 meters, May 23, 1938 (*Klapperich*).

Dictenidia stalactitica is closest to *D. glabrata* Alexander, of western China, which, in the male sex, has the wings almost unpatterned, the antennæ with shorter branches, and the details of structure of the male hypopygium distinct.

DICTENIDIA LUTEICOSTALIS LONGISECTOR subsp. nov.

Very similar to the typical form, differing in the venation, especially the very long Rs which is about one and one-fourth as long as R_3 . The wing pattern is much more distinct, including a short-oval, dark-brown stigma and a conspicuous, dark-brown apex, the inner margin of the latter lying shortly beyond the level of the fork of M_{1+2} . In typical *luteicostalis* the stigma is poorly indicated, pale brown, while the wing apex is clear or virtually so; Rs and R_3 subequal in length.

Habitat.—China (Fukien).

Holotype, female, Kuatun, Fukien, altitude 2,500 to 3,000 meters, May 12, 1938 (*Klapperich*). Paratype, 1 female, Tien-mu-shan, Chekiang, July 27, 1936 (*Piel*); Museum Heude, Shanghai.

DICTENIDIA PICTIPENNIS FASCIATA Coquillett.

Dictenidia fasciata COQUILLETT, Proc. U. S. Nat. Mus. 21 (1898) 304.

Dictenidia pictipennis fasciata ALEXANDER, Philip. Journ. Sci. 60 (1936) 170.

Widely distributed in Japan.

HONSHIU, Lake Chuzenji Shimotsuke, 4,800 feet, July 22, 1923 (*Esaki*); Okkai, Kotsuke, July 28, 1923 (*Esaki*); Tokyo, Imperial University, May 24 to 28, 1922 (*Esaki*); Kofu, Kai (*L. Drouart de Lezey*), Paris Museum; Mount Minomo, Settsu, June 22, 1922 (*Esaki*); Kibune, Kyoto, April 20, 1930 (*Tokunaga*); Otaka Village, Tohaku County, near Mount Daisen, Hoki, June 6, 1930 (*Hibi*); Province of Harima, May 1916. KIUSHIU, Gokanosho, Higo, June 5, 1936 (*Issiki*).

CTENOPHORA NOHIRAI Matsumura.

Ctenophora nohiræ MATSUMURA, Thous. Ins. Japan Addit. 2 (1916) 452-453.

Cnemoncosis hilgendorfi ENDERLEIN, Zool. Anzeig. 52 (1921) 219, 220.

Ctenophora nohirai ALEXANDER, Philip. Journ. Sci. 60 (1936) 167.

HOKKAI, Jozankei, Ishikari, July 29, 1923 (*Kuwayama*). HONSHIU, Kofu, Kai (*L. Drouart de Lezey*), Paris Museum.

PLOCIMAS MAGNIFICUS ENDERLEIN. Plate 2, fig. 31.

Plocimas magnificus ENDERLEIN, Zool. Anzeig. 52 (1921) 226, 227.

Plocimas magnificus ALEXANDER, Philip. Journ. Sci. 66 (1938) 93, 94.

Known from Kwangtung and southern Kiangsi Provinces, southeastern China. A male from Kuatun, western Fukien, altitude 2,500 to 3,000 meters, June 8, 1938 (*Klapperich*).

There is no essential difference in structure between the antennæ of the two sexes, in this regard differing markedly from the condition found in the restricted ctenophorine groups (*Ctenophora* Meigen, *Tanyptera* Latreille, *Pselliophora* Osten Sacken, *Dictenidia* Brullé) where the male has conspicuous branches on the antennal flagellar segments, while the female has the antenna unusually reduced and simple.

Male hypopygium (Plate 2, fig. 31) massive but not conspicuously enlarged. Eight tergite narrow on middorsal portion, sides more expanded. Tergite and sternite entirely fused but their point of union indicated by a glabrous strip. Suture of basistyle indicated only beneath. Ninth tergite with caudal margin broadly and evenly emarginate. Outer dististyle, *od*, darkened, narrowed outwardly; marginal setæ elongate, those of disc very small, subspinous. Inner dististyle, *id*, bilobed, outer lobe a narrow sclerotized blade, its tip subacute. Eighth sternite moderately projecting unarmed.

LONGURIO PULVEROSA (Matsumura).

Togotipula pulverosa MATSUMURA, Thous. Ins. Japan Addit. 2 (1916) 464, 465.

Widely distributed throughout the more southern islands of Japan.

HONSHIU, Mount Akagi, Kotsuke, altitude 6,695 feet, July 28, 1923 (*Esaki*); Hakkotsu, Shinano, July 17, 1918 (*Shiraki*); Mount Ibuki, Mino, June 4, 1921 (*Takeuchi*); Chichibu, Musashi, May 30, 1919 (*Takahashi*); Kobe, Settsu; Dietz Collection, Academy of Natural Sciences, Philadelphia; Kyoto, Yamashiro, altitude 490 feet, July 15, 1928 (*Tokunaga*); Mount Kyusho, Hoki, altitude 860 feet, June 13, 1930 (*Hibi*). SHIKOKU, July 4, 1926 (*Issiki*); KIUSHIU, Near Fukuoka, Chikuzen, June 11, 1924 (*H. Hori*).

CTENACROSCELIS MIKADO (Westwood).

Tipula Mikado WESTWOOD, Trans. Ent. Soc. London (1876) 504.

HONSHIU, Wakayama, Kii, 1928 (*Sakaguchi*); Mount Kyusho, Hoki, altitude 860 feet, June 13, 1930 (*Hibi*); Tokusa, Nagato, August 6, 1922 (*Shiraki*). SHIKOKU, Mount Ishitsuchi, altitude 2,600 feet, August 10, 1925 (*Harukawa*).

CTENACROSCELIS CLAVIPES Edwards.

Ctenacroscelis clavipes EDWARDS, Ann. & Mag. Nat. Hist. (9) 8 (1921) 111-113.

FORMOSA, Chipon, altitude 500 feet, July 4, 1927 (*Issiki*); Hassensan, altitude 2,450 to 6,200 feet, June 7 to 24, 1934 (*Gressitt*).

CTENACROSCELIS HERCULEANUS sp. nov. Plate 3, fig. 32.

Belongs to the *brobdignagius* group; mesonotal scutum brown, median region not brightened; scutellum brownish gray, parascutella dark brown; mediotergite clear ashy gray, darkened laterally in front; wings with a strong grayish tinge, prearcular field and costal border more yellowish brown; stigma brownish yellow, inconspicuous; abdomen blackish gray, central portion of basal tergite brightened; male hypopygium with lateral tergal lobes relatively long; eight sternite with margin bilobed.

Male.—Length, about 35 millimeters; wing, 40; wing expanse, 87; antennæ, about 5.3.

Frontal prolongation of head relatively long, reddish brown above, darker brown on ventral half; nasus conspicuous; palpi brownish black. Antennæ medium brown; flagellar segments only moderately convex beneath; terminal segment elongate. Head yellowish gray in front, clearer gray behind; vertical tubercle simple.

Pronotum yellow, weakly darkened medially. Mesonotal praescutum with ground color yellow, restricted to humeral and lateral portions, disc occupied by four dark-gray stripes that are broadly margined with black, median vitta and interspaces dark brown; scutum brown, median region not brightened, each lobe with two nearly contiguous, dark-gray areas; scutellum brownish gray, parascutella dark brown; mediotergite chiefly clear ashy gray, sides in front darkened, posterior border more buffy. Pleura and pleurotergite clear light yellow; a very narrow and partly broken dorsolongitudinal stripe extending from cervical region and lateral margin of pronotum caudad beneath anterior spiracle to wing root; dorsal posterior angle of pleurotergite darkened. Halteres brown, base of stem restrictedly reddish yellow. Legs with coxæ and trochanters yellow; femora yellow, tips narrowly and rather inconspicuously blackened; tibiæ yellow, tips narrowly blackened, the amount a little less than femoral darkening; posterior tibiæ only a little swollen at tips; tarsi obscure yellow, passing through brownish yellow to brownish black. Wings with a strong grayish tinge, prearcular field and costal border more yellowish brown; stigma pale brownish yellow, inconspicuous; veins brown. Venation: Rs short, less than m-cu; R_2 meeting R_{3+4} nearly its own length before fork of latter; R_4 angularly bent at near two-

thirds its length; petiole of cell M_1 less than m ; $m-cu$ a short distance before fork of M_{3+4} .

Abdomen blackish gray, central portion of first tergite a little brightened; lateral borders of tergites buffy; basal sternites brownish ochreous, soon passing into blackish gray; hypopygium dark, more ventral portions brighter colored. Male hypopygium with tergite (Plate 3, fig. 32, 9t) longer than in *brobdignagius*, median notch deeper, lateral lobes correspondingly longer and with a very abundant delicate pubescence and longer yellow setæ along outer margin. Both dististyles, *id*, *od*, longer than in *brobdignagius*, outer dististyle exceeding inner in length, its apex obtusely rounded. Conformation and armature of eighth sternite, 8s, much as in *brobdignagius*.

Habitat.—China (Fukien).

Holotype, male, Kuatun, altitude 2,500 to 3,000 meters, May 24, 1938 (*Klapperich*).

Ctenacroscelis herculeanus is allied to *C. brobdignagius* (Westwood), yet quite distinct in the coloration of the body and wings and in the structure of the male hypopygium.

CTENACROSCELIS GOLIATH sp. nov. Plate 1, fig. 4; Plate 3, fig. 33.

Belongs to the *brobdignagius* group; mesonotal præscutum with four conspicuous, gray stripes that are insensibly bordered by blackish, mesal edges of intermediate pair forming a more conspicuous, median vitta; scutellum dark brown, parascutella much paler, testaceous yellow; mediotergite brownish gray, lateral and posterior borders yellow; pleura yellow, dorsolongitudinal dark stripe reduced or lacking; legs long, brownish yellow, tips of femora narrowly blackened; wings strongly suffused with reddish brown, prearcular field blackened, cell Sc and stigma more yellowish brown; abdominal tergites dark reddish brown, not at all brightened medially, lateral borders obscure yellow; male hypopygium with eighth sternite unprovided with lobes or hair tufts.

Male.—Length, about 35 millimeters; wing, 43; wing expanse, 92; antennæ, about 5.

Frontal prolongation of head brown; nasus long and conspicuous; palpi brownish black. Antennæ pale brown throughout; flagellar segments scarcely produced beneath, verticils short. Head fulvous brown, posterior vertex and occiput with a narrow, dark-brown, median vitta.

Pronotum infuscated medially, paling to yellow on sides. Mesonotal præscutum brownish yellow with four conspicuous

gray stripes that are insensibly bordered by blackish, mesal edges of intermediate stripes forming a continuous median vitta; scutum reddish brown medially, each lobe with two confluent, gray areas; scutellum dark brown, much darker than testaceous yellow parascutella; mediotergite brownish gray, lateral and posterior borders yellowish. Pleura yellow, without a continuous dark dorsal line, this line represented only by small dark dots above anterior spiracle and before wing root; ventral sternopleurite and ventral anepisternum slightly infuscated. Halteres slender, dark brown, base of stem restrictedly pale. Legs with coxæ and trochanters yellow; femora brownish yellow, tips narrowly blackened; tibiæ yellowish brown, tips very narrowly and insensibly darkened, posterior pair not swollen; tarsi passing through light brown to brownish black; legs long and conspicuous, especially posterior pair. Wings (Plate 1, fig. 4) with a strong reddish-brown tinge, prearcular field more blackened; cell Sc and stigma more yellowish brown; veins brownish yellow. Venation: Sc_2+R_1 short, only a little longer than free tip of Sc_2 ; R_2 before fork of R_{3+2} ; petiole of cell M_1 about one-half m; m-cu long, just before fork of M_{3+4} .

Abdominal tergites dark reddish brown, sublateral and subapical portions darker brown, very narrow posterior margins and broader lateral borders obscure yellow; sternites more reddish brown; hypopygium reddish brown, tergal lobes velvety black, the color produced by abundant black setæ. Male hypopygium with the ninth tergite (Plate 3, fig. 33, 9t) relatively short, apical notch V-shaped, lateral lobes narrowly obtuse at apex; setæ of lobes extending around entire apical margin, not restricted to outer edge as in several allied species. Outer dististyle, *od*, shaped like a dog's ear, narrowed to obtuse tip; setæ sparse and scattered. Inner dististyle, *id*, relatively short, apex with a small, upturned flange; before apex with a long flange or lateral lobe. Eighth sternite, 8s, moderately sheathing, caudal margin evenly, convexly rounded, without lobes or tufts of any kind, the only armature being relatively short and inconspicuous setæ that are more aggregated on the median portion.

Habitat.—China (Fukien).

Holotype, male, Kuatun, altitude 2,500 to 3,000 meters, June 8, 1938 (*Klapperich*).

The nearest ally of the present fly is *Ctenacroscelis brobdignagius* (Westwood), which differs conspicuously in the coloration.

tion and in the structure of the male hypopygium. In *brobdignagius* there is a conspicuous, pale, median stripe extending from the mesonotal suture caudad onto the abdomen. The present fly is well distinguished by the simple eighth sternite of the male hypopygium.

TIPULA (NIPPOTIPULA) KLAPPERICHI sp. nov. Plate 1, fig. 5.

General coloration yellow, mesonotal præscutum and scutum very conspicuously patterned with dark brown; antennal flagellum uniformly black; legs black, femoral bases obscure yellow; wings with a brownish tinge, patterned with darker brown; a narrow, continuous seam around wing apex, not broken by pale spots in medial field; an incomplete yellow band beyond stigma; abdomen dark brown, posterior borders of outer segments reddish brown.

Female.—Length, about 42 millimeters; wing, 24.

Frontal prolongation of head brownish yellow, with golden setæ; nasus lacking; palpi black. Antennæ with scape and pedicel yellow, flagellum black; basal flagellar segments subcylindrical, with poorly developed basal enlargements, the outer segments with the swellings more developed; thirteenth segment elongate, only a little shorter than penultimate, strongly narrowed outwardly; verticils very slightly exceeding segments in length. Head orange-yellow; vertical tubercle very low.

Pronotum light yellow, infuscated medially. Mesonotal præscutum light yellow with three very conspicuous, entire, dark-brown stripes, median stripe split by a capillary, gray, median vitta; lateral stripes straight; scutum yellow, each lobe with two confluent, dark-brown areas; scutellum yellow, weakly infuscated, parascutella light yellow; postnotum light yellow, mediotergite with paired darkened areas on posterior portion; mesonotum with abundant erect setæ, longer and more conspicuous on the more posterior sclerites. Pleura yellow, anepisternum suffused with reddish brown; ventral sternopleurite and meron abruptly gray pruinose; dorsopleural membrane yellow. Halteres with stem pale brown, knob pale yellow. Legs with coxæ yellow-pollinose, fore pair darkened in front; trochanters yellow; femora brownish black, the bases obscure yellow; tibiæ and tarsi black. Wings (Plate 1, fig. 5) with a brownish tinge, patterned with darker brown; stigma brown, encircled by light yellow, much more extensive and distinct outwardly as a post-stigmal brightening in cells Sc₂, R₂, and R₃; major dark areas at origin of Rs, on anterior cord and at near midlength of outer

radial field; less distinct brown washes at near midlength and at outer end of cell M, at near midlength of cell Cu and at axillary border; continuous brown seams include wing tip and along vein 2d A; cell Sc a trifle darker than cell C; no pale marginal spots in any cells of wing; dark postarcular area in cells R and M virtually lacking; veins brown. R_{1+2} without trichia; remaining outer radial branches, together with M_{1+2} , with trichia. Venation: Rs exceeding three times m-cu, the latter shortly before midlength of M_{3+4} .

Abdomen elongate, dark brown, yellowish gray-pruinose; posterior borders of intermediate and outer segments, especially sternites, reddish brown; lateral tergal borders paler gray. Ovipositor with cerci relatively stout and straight, outer faces grooved, tips obtusely rounded; hypovalvæ shorter and deeper, paler yellow, tips narrowly obtuse to subtruncate.

Habitat.—China (Fukien).

Holotype, female, Kuatun, altitude 2,500 to 3,000 meters, April 14, 1938 (*Klapperich*).

Tipula (*Nippotipula*) *klapperichi* is named in honor of the collector, who has added most materially to our knowledge of the insect fauna of the higher mountains of western Fukien. The fly is entirely distinct from other species of the subgenus so far discovered in eastern Asia. The continuous darkened border of the wing apex readily differentiates it from other regional species.

TIPULA (FORMOTIPULA) SPOLIATRIX sp. nov. Plate 1, fig. 6; Plate 3, fig. 34.

General coloration black, præscutum with four dark-gray stripes; antennæ black throughout; wings with a weak blackish tinge, stigma long oval, dark brown; R_{1+2} preserved; abdomen with segments two to four orange, outer segments black; male hypopygium with ninth tergite very large and massive, caudal margin with six small, blackened, decurved points; dististyle with two conspicuous, black spines.

Male.—Length, about 12 millimeters; wing, 14; antennæ, about 3.8.

Female.—Length, about 13 millimeters; wing, 13 to 14; antennæ, 3.

Frontal prolongation of head black, sparsely pruinose; nasus distinct; palpi black. Antennæ black throughout; flagellar segments with basal swellings only feebly developed; verticils subequal in length to segments. Head velvety black, pruinose on orbits and behind; vertical tubercle low, weakly bifid.

Pronotum black. Mesonotal præscutum black, with four dark-gray stripes; scutum blackish gray; posterior sclerites of notum pruinose. Pleura black, sparsely pruinose. Halteres black. Legs black, femoral bases vaguely and restrictedly brightened. Wings (Plate 1, fig. 6) with a weak blackish tinge; stigma long-oval, dark brown; veins brownish black. Venation: Rs subequal in length to long m-cu; R_{1+2} preserved.

Abdomen with basal tergite orange, brownish black on sides; segments two to four, inclusive, orange; outer segments, including genitalia of both sexes, intense black. Male hypopygium (Plate 3, fig. 34) relatively small but compact. Ninth tergite, 9t, very large and massive, provided with abundant erect, dark setæ; caudal margin beneath with six small, blackened points, separated by shallow, rounded notches. Apex of lobe of basistyle short and stout, with coarse setæ that are nearly as long as the apex itself. Dististyle, *d*, with apical beak slender, decurved; face of style with two blackened spines, basal spine long and slender, nearly straight.

Habitat.—China (Fukien).

Holotype, male, Kuatun, altitude 2,500 to 3,000 meters, June 7, 1938 (*Klapperich*). Allotopotype, female, June 5, 1938. Paratopotypes, 2 females, May 23 to June 12, 1938.

Tipula (*Formotipula*) *spoliatrix* is entirely different from the other somewhat similar regional species of the subgenus. The structure of the male hypopygium furnishes the most distinctive specific characters.

TIPULA (ACUTIPULA) PLATYCANTHA Alexander.

Tipula (*Acutipula*) *platycantha* ALEXANDER, Philip. Journ. Sci. 54 (1934) 314, 315.

SZECHWAN, Kingfoo Shan, July 1932 (*Gaines Liu*) Collector's No. 769; Kwanshien, altitude 3,500 feet, August 6, 1937 (*Franck*); Beh Luh Din (Peluhting), altitude 6,000 feet, July 27, 1933 (*Graham*).

TIPULA (ACUTIPULA) LUTEINOTALIS sp. nov. Plate 1, fig. 7; Plate 3, figs. 35 and 36.

Mesonotal præscutum light gray with four darker-gray stripes; postnotal mediotergite clear golden-yellow; wings brownish gray, unpatterned, costal border and stigma darker; a yellowish-white obliterative area before stigma; abdominal tergites brownish gray, with a broken, sooty black, sublateral stripe, median stripe more diffuse and poorly defined; male hypopygium with ninth tergite broadly produced, its apex split by a deep notch

into two lobes; outer dististyle long and narrow; inner dististyle with apical beak slender, blackened; face of style with two powerful spines.

Male.—Length, about 20 to 22 millimeters; wing, 24 to 26; antennæ, about 5 to 5.3.

Female.—Length, about 26 to 27 millimeters; wing, 22 to 23.

Frontal prolongation of head brown; nasus long and conspicuous; palpi dark brown. Antennæ with scape light brown, pedicel yellow, flagellum brown; verticils very long. Head gray, posterior orbits narrowly more buffy; vestiture of head black.

Pronotum light yellow, weakly darker laterally. Mesonotal præscutum light gray, with four darker-gray stripes, mesal edges of intermediate pair slightly darker; setæ of interspaces sparse and weak; scutum gray, each lobe with two entirely separate, darker-gray areas; scutellum brownish yellow with golden pubescence, parascutella darker; mediotergite clear golden yellow. Pleura buffy yellow, scarcely variegated with darker; dorsopleural membrane somewhat darker yellow. Halteres with stem black, knob a little paler, base of stem restrictedly yellow. Legs with coxæ buffy yellow; trochanters yellow; femora yellow, tips rather narrowly and weakly darkened; tibiæ brownish yellow, tips very narrowly dark brown; tarsi passing through dark brown to black. Wings (Plate 1, fig. 7) with a brownish-gray tinge, prearcular field and costal border a little darker, especially cell Sc; stigma brown, preceded by a pale yellowish-white, obliterative area; pale areas across cell 1st M_2 less conspicuous, more whitened; veins dark brown. Venation: Rs variable in length, from slightly longer than m-cu to one and one-half as long as this vein; petiole of cell M_1 subequal to m; m-cu at or very close to fork of M_{3+4} .

Abdominal tergites brownish gray, with a broken, sooty-black, sublateral, stripe, lateral borders narrowly paler; median tergal vitta paler and more diffuse; sternites brownish gray, outer segments and hypopygium darker gray. Male hypopygium of moderate size. Ninth tergite (Plate 3, fig. 35, 9t) with median projection broad, at apex divided by a deep median split into two lobes. Outer dististyle (Plate 3, fig. 36, *od*) unusually narrow, length exceeding three times greatest width, margin entire. Inner dististyle, *id*, with apical beak long and narrow, blackened; dorsal crest relatively low; on face of style with two powerful spines, the more basal spine larger and more nearly straight.

Habitat.—China (Fukien).

Holotype, male, Kuatun, Fukien, altitude 2,500 to 3,000 meters, April 14, 1938 (*Klapperich*). Allotopotype, female, April 8, 1938. Paratopotypes, 1 male and 1 female, April 12 to 14, 1938; paratype, 1 male, Tien-mu-shan, northern Chekiang, May 21, 1937 (*Suenson*).

Tipula (*Acutipula*) *luteinotalis* is quite distinct from the other now numerous Chinese species of the subgenus having unpatterned wings. The clear yellow postnotum, and especially the structure of the male hypopygium, readily separate it from species with a somewhat similar inner dististyle, as *T. (A.) biramosa* Alexander and *T. (A.) bihastata* sp. nov.

TIPULA (ACUTIPULA) BIHASTATA sp. nov. Plate 1, fig. 8; Plate 3, figs. 37 and 38.

Mesonotum yellowish gray, præscutum with four more brownish-gray stripes; pronotum orange-yellow; pleura and ventral pleurotergites uniformly yellow; antennæ relatively long, flagellum brownish black; wings grayish brown, stigma and cell Sc darker brown; a restricted, dark seam on m-cu; abdominal tergites obscure yellow, with sublateral, black stripes, terminal segments uniformly darkened; median lobe of ninth tergite of hypopygium relatively broad, bifid at apex; inner dististyle with apical portion produced into two strong, slender spines; eighth sternite with a setiferous lobe on caudal margin on either side of median line.

Male.—Length, about 18 millimeters; wing, 21.5; antennæ, about 5.

Frontal prolongation of head brownish black; nasus conspicuous; palpi with basal two segments brownish black; outer two segments dark brown, with paler incisures. Antennæ relatively long, as shown by measurements, if bent backward extending to beyond base of halteres; scape and pedicel yellow, first flagellar segment light brown, remaining segments brownish black; basal enlargements of segments small but distinct, with conspicuous verticils that are a little longer than the segments. Head dark gray, posterior orbits narrowly paler; anterior vertex about two and one-half times diameter of scape at its base.

Pronotum clear orange-yellow throughout. Mesonotal præscutum with four more brownish-gray stripes, centers of intermediate pair a little paler, leaving brown borders that are subequal in width to median interspace; mesal edge of lateral stripe merging gradually into ground color of interspace; scutum yellowish gray, each lobe variegated with darker-brown

areas; posterior sclerites of notum yellowish gray, lateral borders of mediotergite more yellow pollinose, posterior lateral angles darkened. Pleura and pleurotergite uniformly yellow, unmarked, anatergite of pleurotergite gray-pruinose. Halteres dark brown, base of stem and apex of knob pale yellow. Legs with coxæ and trochanters yellow; femora narrowly yellow at base, passing through brown to black; tibiæ and tarsi brownish-black; claws with basal tooth. Wings (Plate 1, fig. 8) with a grayish-brown tinge, cell Sc and stigma darker brown; prearcular field and cell C slightly more yellow than remainder of ground; a narrow, dark seam on m-cu; oblitative areas before cord conspicuous; veins black. Venation: Rs subequal in length to m-cu; m a little longer than petiole of cell M_1 .

Abdominal tergites obscure yellow, with sublateral black stripes that are narrowly interrupted at posterior borders; lateral margins of tergites paling to gray; basal sternites yellow; outer segments, including hypopygium, passing into black. Male hypopygium with caudal lobe of tergite (Plate 3, fig. 37, 9t) relatively broad, bifid at apex, lobes rounded and set with blackened, peglike spines. Outer dististyle entirely pale, rather broadly dilated on basal three-fourths, apex strongly narrowed. Inner dististyle (Plate 3, fig. 39, *id*) with apical portion produced into two strong, slender spines from a common, fused, basal portion; outer spine stouter and a little longer than inner; rostral portion of style heavily blackened. Eighth sternite sheathing, apex with two lobes that are provided with conspicuous setæ, one lobe on either side of pale membrane of median line.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Hwa Ien Ting Temple, altitude 6,500 feet, June 15, 1939 (*Tsen*).

The male hypopygium of the present fly most resembles that of *Tipula* (*Acutipula*) *biramosa* Alexander and *T. (A.) luteinotalis* sp. nov., which differ in the details of structure of the male hypopygium.

TIPULA (ACUTIPULA) STENOTERGA sp. nov. Plate 1, fig. 9; Plate 4, fig. 39.

General coloration of mesonotum yellowish gray, præscutum with four narrow, darker stripes, intermediate pair dark-bordered; antennæ relatively short, flagellum brown; knobs of halteres yellow; wings patterned, including a major area in cell Cu; outer radial field chiefly darkened; abdominal tergites

orange-yellow, narrowly trivittate with brown, outer segments uniformly blackened; male hypopygium with median tergal lobe narrow but bifid at tip; eight sternite with a median, pale lobe that is densely clothed with long, yellow setæ; additional groups of long setæ on either side of middle of sternite.

Male.—Length, about 18 millimeters; wing, 21.5; antennæ, about 3.5.

Frontal prolongation of head grayish brown; nasus distinct; palpi pale brown. Antennæ relatively short; scape and pedicel yellow; first flagellar segment yellow, succeeding segments brown; basal enlargements of segments very small; verticils long. Head gray; anterior vertex approximately three times as wide at base as scape.

Pronotum obscure yellow. Mesonotal præscutum yellowish gray, with four stripes, narrow, darker brownish-gray intermediate pair with inner margins on anterior half narrowly more blackened, cephalic portion of sclerite more extensively darkened; lateral stripes less clearly defined; posterior sclerites of notum gray, variegated with darker on mediotergite, forming a more or less distinct V-shaped figure. Pleura yellow, pleurotergite darkened. Halteres elongate, brown, extreme base of stem and knob more yellowish. Legs with coxæ and trochanters yellow; remainder of legs black, femoral bases narrowly obscure yellow; claws (male) toothed. Wings (Plate 1, fig. 9) grayish subhyaline, patterned with darker, including usual cloud at near midlength of cell Cu; outer radial field chiefly darkened, only distal half of cell R_5 more brightened, this area similarly involving more than one-half of cell 1st M_2 and narrow seams along most anterior medial veins; outer fourth of cell M darkened; cell Sc and stigma uniformly dark; prearcular field and cell C slightly more yellow than ground; a clearer hyaline, obliterative area along cord, further involving bases of cells M_1 , 2d M_2 , M_3 , and M_4 ; veins brown. Venation: Rs subequal to or a trifle longer than m-cu; cell 2d A wide.

Abdominal tergites orange-yellow, narrowly trivittate with dark brown, becoming more distinct on second and succeeding tergites, interrupted at posterior borders of segments; basal sternites yellow, outer segments more obscure; outermost segments, including hypopygium, uniformly blackened. Male hypopygium (Plate 4, fig. 39) with median lobe of tergite, 9t, unusually narrow but distinctly bilobulate at apex, lobules and lateral margins of stem back from apex with scattered, blackened spines. Outer dististyle, *od*, entirely pale, strongly nar-

rowed and attenuated outwardly, apex acute. Inner dististyle, *id.*, of peculiar conformation, outer lobe shaped somewhat like head and beak of a bird, such as a *Phasianus*, with conspicuous, appressed, antrorse, spinous setæ; beak relatively slender, chiefly pale. Eighth sternite, 8s, with a conspicuous median lobe that is densely clothed with long, delicate, silken, yellow setæ that are longer than the lobe itself; ventral surface of sternite, below lobe, on either side of median line with extensive areas of long, pale setæ, the total providing three conspicuous sternal groups of setæ of unusual length (in order to avoid confusion, only a few of the actual setæ are figured, but the stippled dots and punctures indicate their position).

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Summit, altitude 11,000 feet, June 17, 1938 (*Tsen*).

Tipula (*Acutipula*) *stenoterga* is entirely distinct from other described members of the subgenus, differing especially in the structure of the male hypopygium, notably the inner dististyle and the eighth sternite.

TIPULA (VESTIPLEX) CREMERI sp. nov. Plate 1, fig. 10.

General coloration of præscutum obscure yellow, with four pale-gray stripes that are vaguely bordered by darker; præscutum with a capillary, black, median vitta; scutellum yellow with a brownish-black median line; femora brownish yellow, tips rather narrowly blackened; wings with a strong brown suffusion, unpatterned; cells Sc, Cu₁, and stigma slightly darker brown; Rs long and straight, nearly three times m-cu; abdominal tergites yellow with a very broad, black, median stripe and narrow inconspicuous lateral lines; teeth of the cerci small but numerous.

Female.—Length, about 23 millimeters; wing, 20.

Frontal prolongation of head relatively long, black, sparsely gray-pruinose; nasus elongate; palpi black. Antennæ black, pedicel a little paler; flagellum with verticils that slightly exceed the segments in length; terminal segment oval. Head dark gray with black vestiture; a very delicate, scarcely evident, capillary, median vitta; anterior vertex broad, tubercle scarcely apparent.

Pronotum broadly darkened medially, more buffy on sides. Mesonotal præscutum with ground color obscure yellow, usual four stripes pale gray, inconspicuous against ground, their borders barely indicated by darker; a very conspicuous but narrow, black, median vitta on anterior three-fourths of sclerite,

becoming obsolete behind; scutum yellow, lobes pale gray, vaguely margined with slightly darker; scutellum yellow, with a conspicuous, brownish-black, median vitta, parascutella dusky; postnotum buffy yellow. Pleura yellow-pollinose, ventral sternopleurite slightly grayish; dorsopleural membrane weakly infumed. Halteres with stem pale brown, knob blackened. Legs with coxæ yellow pollinose; trochanters yellow; femora brownish yellow, tips rather narrowly blackened; tibiæ yellowish brown, tips narrowly darker; tarsi black, proximal ends of basitarsi paler. Wings (Plate 1, fig. 10) with a strong brown suffusion, without pattern; cells Sc and Cu₁, with stigma, slightly darker brown; oblitative areas poorly indicated, lying before stigma and across base of cell 1st M₂; veins brown. Venation: Rs long and straight, nearly three times m-cu, its base narrowly pale to subobsolete; vein R₁ incrassated to point of fusion with Sc₂, then markedly weaker and arcuated; cell 1st M₂ long, basal section of M₁₊₂ less than one-half second section; m-cu at fork of M₃₊₄.

Abdominal tergites yellow, with a very broad, black, continuous, median stripe; lateral stripes very narrow and poorly indicated, beginning as a faint stripe on third tergite, becoming somewhat wider and more conspicuous on outer segments, lateral borders of segments narrowly buffy; posterior borders of tergites narrowly gray-pruinose; basal sternites brownish yellow, outer segments more uniformly infuscated; genital shield polished black. Cerci with lower teeth unusually numerous (approximately 30 in number) and acute, especially intermediate teeth.

Habitat.—China (Fukien).

Holotype, female, Kuatun, altitude 2,500 to 3,000 meters, April 11, 1938 (*Klapperich*).

I am greatly pleased to name this fly in honor of Dr. Ernst Cremer, of the Zoologisches Forschungsinstitut in Bonn, to whom I am indebted for the opportunity of studying the Klapperich collection. Very few of the known species of *Vestiplex* have unpatterned wings. The present fly is readily told from the latter by the very strongly infumed wings, the broad, continuous, median, black stripe on the abdominal tergites, and by the unusually small and numerous teeth of the cerci.

TIPULA (VESTIPLEX) BIFIDA Alexander.

Tipula (Vestiplex) bifida ALEXANDER, Bull. Mus. d'Hist. Nat. Paris (1921) 539, 540.

One male, Kuatun, Fukien, altitude 2,500 to 3,000 meters, May 26, 1938 (*Klapperich*). The antennæ are a little longer and the antennal flagellum more uniformly darkened than in other specimens before me.

TIPULA (OREOMYZA) LIUI sp. nov. Plate 1, fig. 11; Plate 4, fig. 40.

Large (wing, male, over 25 millimeters); general coloration yellow, præscutum with four narrow, brown stripes; scutellum and mediotergite with narrow, median vittæ; pleura yellow, with a narrow, more or less interrupted, dorsal, brown stripe; femora yellow, the tips blackened; midfemora broadly blackened beyond base; wings pale yellow, sparsely patterned with brown; m-cu very long, nearly equal in length to distal section of Cu_1 and only a little shorter than long Rs; cell 1st M_2 pointed at inner end; M_{3+4} long; abdomen yellow, lateral borders conspicuously blackened; male hypopygium with tergite large, outer lateral angles produced into very long, conspicuous blades; a single dististyle of relatively simple structure; eighth sternite simple, scarcely produced.

Male.—Length, about 22 millimeters; wing, 26.5; antennæ, about 4.5.

Frontal prolongation of head relatively short, yellow; nasus stout; palpi dark brown, outer segment paler. Antennæ of moderate length; scape, pedicel, and basal three or four flagellar segments yellow, outer segments passing into light brown; flagellar segments weakly incised; longest verticils exceeding segments in length. Head yellow, genæ more darkened; vertical tubercle low and flat.

Pronotum yellow. Mesonotal præscutum yellow with four narrow, brown stripes, intermediate pair narrowly separated by a brownish-yellow, median line; posterior sclerites of notum yellow, each scutal lobe with two brownish areas; median line of scutellum broadly, of mediotergite very narrowly, darkened. Pleura yellow, with a narrow, interrupted, brown, longitudinal stripe, extending from cervical region across ventral pronotum and dorsal pleurites to abdomen, passing through root of halteres. Halteres with stem unusually long, pale yellow, knob small, brown. Legs with coxæ and trochanters yellow; fore femora yellow, tips rather broadly dark brown; tibiæ yellow, tips weakly darkened; basitarsi obscure brownish yellow, remainder of tarsi passing into black; midfemora beyond narrow, yellow base with succeeding fourth of segment blackened, followed by an even wider, yellow ring before narrowly blackened

tip; tibiae and tarsi as in forelegs; hind legs broken but from analogy presumably with black subbasal ring of femora present and even more extensive than on middle legs; claws (male) with basal tooth; femora with abundant erect setae. Wings (Plate 1, fig. 11) pale yellow, sparsely patterned with brown, including small spots at origin of Rs, anterior cord and tip of vein R_{1+2} ; stigma brownish yellow, a little darker than ground; veins yellow. Macrotrichia well distributed on veins beyond cord, including base of R_{1+2} ; squama naked; postsquamal fringe very long and conspicuous. Venation: R_{1+2} preserved, apex bullate; Rs long, about a fourth longer than very long m-cu; r-m reduced; inner end of cell 1st M_2 strongly pointed; m-cu at fork of long M_{3+4} ; m-cu nearly as long as distal section of Cu_1 , cell M_4 very wide at base.

Abdomen yellow, tergites with conspicuous, black, lateral borders to form evident stripes. Male hypopygium (Plate 4, fig. 40) with tergites entirely separate from sternite; basistyle partly fused with sternite, suture indicated on ventral portion. Ninth tergite, 9t, very extensive, longer than broad, with a narrow but deep median notch, very long and conspicuous lateral lobes produced caudad and slightly laterad into flattened, pale blades; viewed from above these blades appear narrower and subacute; surface of tergite with very abundant setae, lacking on about cephalic fifth, longer and more conspicuous on lateral portions and on outer blades, shorter and more spinous adjoining median incision. Basistyle not produced apically beyond point of insertion of dististyle. A single dististyle, *d*, consisting of an outer, flattened, disclike lobe with darkened border, and a small, more posterior, truncated lobe that is produced into a small spine; from base of style on mesal face a flattened blade that narrows into a blackened rod, pointed at tip. Eighth sternite relatively short, caudal border very slightly produced medially without lobes or other armature; median area at margin provided with short, erect setae.

Habitat.—China (Anhwei).

Holotype, male, Taipinghsien, May 1932 (*Liu*), collector's No. 758.

I take very great pleasure in dedicating this species to Mr. Gaines Liu, to whom I am very much indebted for many interesting Chinese Tipulidæ. I cannot indicate any close allies of this very distinct and conspicuous crane fly. The great length of m-cu is suggestive of species of *Schummelia* Edwards, but the

assignment to *Oreomyza* Pokorný seems to be more nearly correct.

TIPULA (OREOMYZA) KUATUNENSIS sp. nov. Plate 1, fig. 12; Plate 4, figs. 41 and 42.

Belongs to the *mutila* group; general coloration of mesonotum gray, with four entire, brown stripes, intermediate pair confluent behind; setigerous punctures very conspicuous; antennæ elongate, flagellum black; legs brownish black, femoral bases restrictedly obscure yellow; wings subhyaline, restrictedly patterned with brown; R_{1+2} atrophied; abdominal tergites reddish brown, dark brown medially; outer segments brownish black; male hypopygium with tergite broadly notched medially, lateral lobes obliquely truncated, dorsal face of sclerite with a conspicuous furrow; blade of outer dististyle unusually broad; inner dististyle with beak relatively stout; eighth sternite with a conspicuous fringe of yellow setæ.

Male.—Length, about 11 millimeters; wing, 12.8; antennæ, about 5.

Frontal prolongation of head relatively long, a little shorter than remainder of head, brown, dorsal surface heavily pruinose; nasus elongate; palpi black. Antennæ relatively long, as shown by measurements; scape pale, sparsely pubescent; pedicel brownish yellow, flagellum black, proximal portion of first segment paler; flagellar segments moderately incised; longest verticils unilaterally arranged, a little shorter than segments; verticils of lower face very short, subspinous. Head light gray, with a poorly indicated, slightly impressed, median vitta; setigerous punctures moderately conspicuous; vertical tubercle low.

Pronotum gray. Mesonotal præscutum gray, with four entire, brown stripes, intermediate pair of stripes widely separated in front, narrowed behind, confluent before suture; on posterior half of median interspace with an additional brown vitta that likewise becomes confluent behind with intermediate stripes; lateral stripes narrow; setigerous punctures very large and conspicuous, brown; scutum gray, each lobe variegated by two dark-brown areas, median region further darkened; scutellum gray, vaguely darkened medially; postnotum gray, with a capillary, dusky, median vitta. Pleura light gray; dorsopleural membrane more yellowish. Halteres dusky, base of stem paler. Legs with coxæ light gray; trochanters yellow; femora brownish black, bases restrictedly obscure yellow; tibiæ and tarsi black. Wings (Plate 1, fig. 12) subhyaline, restrictedly patterned with brown;

cell C beyond h infumed; cell Sc yellow; stigma dark brown; restricted brown clouds at origin of Rs, along cord, and in distal end of outer radial field; a conspicuous, brown seam along distal three-fourths of vein Cu in cells M and Cu₁, interrupted by a pale spot toward outer end of cell M; veins of outer radial and medial fields very narrowly seamed with darker; vein 2d A narrowly seamed by brown throughout its length; veins brown. Venation: R₁₊₂ atrophied, represented only by a short basal spur; Rs of moderate length, about twice m-cu; m-cu a short distance before fork of M₃₊₄; petiole of cell M₁ more than one and one-half as long as m.

Abdominal tergites reddish brown, dark brown medially, on segments uniformly brownish black; basal sternites reddish, outer segments gray-pruinose. Male hypopygium (Plate 4, fig. 41) with basistyle entire, unarmed. Ninth tergite, 9t, with caudal margin broadly notched, dorsal surface back from base of this notch conspicuously furrowed; lateral lobes obliquely truncated. Outer dististyle (Plate 4, fig. 42, *od*) with blade unusually broad, width approximately two-thirds the length. Inner dististyle (Plate 4, fig. 42, *id*) with beak blackened, relatively stout. Eighth sternite (Plate 4, fig. 41, 8s) with caudal margin very evenly rounded, provided with abundant yellow setæ arranged in two groups, outermost setæ longest, inner setæ short and inconspicuous; besides the major groups of setæ, disc of sternite back from margin provided with a very dense transverse row of setæ.

Habitat.—China (Fukien).

Holotype, male, Kuatan, altitude 2,500 to 3,000 meters, May 26, 1938 (*Klapperich*).

The nearest allied species is *Tipula* (*Oreomyza*) *savionis* Alexander, occurring at lower altitudes than the present fly in eastern China. This latter species is readily told from the present fly by the bicolored antennæ, yellow halteres, distinct wing pattern and venation, and especially in the structure of the male hypopygium, as the tergite and both dististyles.

TIPULA (LUNATIPULA) FURIOSA sp. nov. Plate 1, fig. 13, Plate 4, fig. 43.

General coloration yellow, præscutum in front with a conspicuous, brown, median area; antennæ (male) relatively elongate; wings with a brown tinge, prearcular and costal fields more yellowish; stigma conspicuous, dark brown; male hypopygium large; ninth tergite with two submedian lobes and a third,

more depressed, median blade; inner dististyle large and complex, its posterior portion produced into a blackened, trispinous blade; eighth sternite with two pale lobes on caudal margin.

Male.—Length, about 14 to 15 millimeters; wing, 19 to 20; antennæ, about 6.

Female.—Length, about 21 millimeters; wing, 20.

Frontal prolongation of head obscure brownish yellow, darker on sides and beneath; nasus conspicuous; palpi brownish black, incisures and extreme tip of terminal segment paler. Antennæ (male) relatively long; basal three segments yellow, succeeding flagellar segments weakly bicolored, pale brown, basal enlargements darker; outer segments uniformly dark brown; basal enlargements of segments relatively conspicuous; verticils shorter than segments; terminal segment reduced. Front and anterior vertex yellow, posterior vertex and occiput brownish gray; vertical tubercle relatively conspicuous, very weakly notched medially.

Pronotum broadly dark brown medially, paling to yellow on sides. Mesonotal præscutum light yellow, patterned with three olive-green stripes, median stripe expanded and dark brown on cephalic half; scutum yellow, lobes chiefly olive-brown, mesal-cephalic portions a little darker; scutellum obscure yellow; mediotergite yellow. Pleura yellow. Halteres relatively long, stem yellow, knob infuscated. Legs with coxæ and trochanters yellow; femora obscure yellow to brownish yellow, tips narrowly dark brown; tibiæ and tarsi dark brown, tibial tips narrowly darker; claws (male) with basal tooth. Wings (Plate 1, fig. 13) with a brownish tinge, prearcular and costal fields more yellow; stigma conspicuous, dark brown; a small brown cloud on anterior cord; oblitative areas restricted; veins brown. Squama with setæ; veins beyond cord with trichia. Venation: R_{1+2} persistent, naked; m-cu at fork of M_{3+4} .

Abdomen yellow, tergites with a broken median stripe beginning on second segment, becoming more expanded on outer segments, on sixth and succeeding segments uniformly blackened; third and succeeding segments with poorly indicated, lateral stripes; hypopygium large. Ovipositor with cerci elongate, straight, moderately compressed, tips a trifle expanded, obtuse; hypovalvæ a little deeper, tips blunt, obtuse. Male hypopygium (Plate 4, fig. 43) with tergite and sternite separated; basistyle large, cut off by a suture on ventral half, on dorsal half position of suture indicated by a depression; caudal mar-

gin of basistyle gently emarginate, not produced. Ninth tergite, 9t, with an earlike triangular lobe on either side of a deep median incision, with a further median lobe between and at a slightly lower level. Dististyle, *d*, virtually single, usual outer style represented by a small cylindrical lobe on margin of the very large, compressed, inner style; posterior portion of style produced into a blackened blade that bears three unequal spines, intermediate spine largest. Eighth sternite, 8s, moderately sheathing, black, on either side of a median incision produced into a pale, flattened lobe that bears numerous, very long, yellow setæ.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Shuang Fei Chiao (Flying Bridges Temple), altitude 3,000 feet, June 22, 1935 (Graham). Allotopotype, female. Paratopotype, male.

Tipula (Lunatipula) furiosa is very distinct from the other regional species of the subgenus. The rather remarkable male hypopygium is quite distinctive.

TIPULA TETRACANTHA Alexander.

Tipula tetracantha ALEXANDER, Philip. Journ. Sci. 35 (1928) 457, 458.

Well distributed in southern Japan.

HONSHIU, Mount Daisen, Hoki, July 2, 1931 (Tokunaga), SHIKOKU, July 4, 1926 (*Issiki*), type. KIUSHIU, Inunakitoge, Chikuzen, June 7, 1931 (*Esaki, Hori & Yasumatsu*).

TIPULA PARVAURICULA sp. nov. Plate 1, fig. 14; Plate 4, fig. 44.

Belongs to the *filicornis* group; general coloration orange, præscutum unpatterned; antennæ of male subequal in length to body; wings with a pale-brown tinge, stigma a little darker; abdomen yellow, with a conspicuous subterminal black ring in both sexes; male hypopygium large, compressed; caudal margin of ninth tergite produced into two slender, erect, spinous points; ventrolateral portions of tergite produced into low lobes that are densely set with blackened points; both dististyles pale, broadly flattened, without spinous points.

Male.—Length, about 17 to 18 millimeters; wing, 17.5 to 19; antennæ, about 18 to 21.

Female.—Length, about 18 to 19 millimeters; wing, 18 to 20.5; antennæ, about 3.7 to 3.8.

Frontal prolongation of head obscure yellow; nasus distinct; palpi pale brown. Antennæ of male very elongate, as shown by measurements; scape and pedicel yellow, flagellum dark brown;

flagellar segments long-cylindrical, with an abundant, erect, pale pubescence, and long, black verticils that are well distributed over the length of the segments, the longest less than one-half length of segment; antennæ of female normal, short. Head orange; anterior vertex glabrous, broad, without tubercle.

Thorax uniformly orange, unpatterned; setæ of præscutal interspaces pale, small, sparse. Halteres with stem yellow, knob weakly darkened. Legs with coxæ orange-yellow; trochanters yellow; remainder of legs brownish yellow, terminal tarsal segments darker; claws of male with a strong tooth, of female simple. Wings (Plate 1, fig. 14) with a pale-brown tinge, stigma a little darker, cell Sc more brownish yellow; veins brown. Venation: R_{2+3} straight, in alignment with Rs, the latter nearly one and one-half as long as m-cu; cell 2d A broad.

Abdomen yellow, with a conspicuous, subterminal, black ring in both sexes, in male including almost all of segments six and seven; hypopygium orange. Male hypopygium (Plate 4, fig. 44) large and compressed. Caudal margin of tergite, 9t, produced into two slender, earlike, erect, spinous points; ventro-lateral portions of tergite produced into low lobes that are densely set with blackened points. Dististyles, *id*, *od*, pale, broadly flattened, shaped as figured; outer style with a slender, pale rod along cephalic or upper border, close to margin. Ovipositor with small, fleshy valves, as in group.

Habitat.—China (Fukien).

Holotype, male, Kuatun, altitude 2,500 to 3,000 meters, May 14, 1938 (*Klapperich*). Allotopotype, female, pinned with type. Paratopotypes, 6 males and females, May 10 to 27, 1938.

Tipula parvauricula is very distinct from the members of the *filicornis* group so far described. In an earlier report¹ I had referred this group to the subgenus *Acutipula* Alexander. Later this position became untenable, and at the present time I do not regard it as advisable to definitely refer the members of the group to any existing subgeneric division.²

TIPULA RESERVATA sp. nov. Plate 1, fig. 15.

General coloration of mesonotal præscutum buffy with four conspicuous dark-brown stripes, cephalic ends of intermediate pair of stripes more pruinose; head light gray, with three brown areas on posterior vertex; mediotergite light gray with a ca-

¹ Philip. Journ. Sci. 36 (1928) 458, 459.

² Ibid. 57 (1935) 85.

pillary dark-brown median vitta; wings grayish, cell Sc and proximal end of stigma yellow; vein Sc₁ preserved as a short, erect element; R₁₊₂ entire; cell M₄ at base about one and one-third as wide as at apex; abdomen brownish yellow, with a broad, dark-brown, median stripe; ovipositor with long, slender cerci.

Female.—Length, about 17 millimeters; wing, 18.5.

Frontal prolongation of head brownish gray; nasus elongate, buffy gray, palpi black. Antennæ 13-segmented; scape and pedicel yellow; first flagellar segment brownish yellow, remainder of flagellum pale brown; basal enlargements of segments small; verticils relatively long, a little shorter than segments; terminal segment reduced to a small thimble that is subequal in size to basal enlargement of penultimate segment. Head light gray, with a conspicuous, brown, median stripe that is narrowed at either end, extending from the scarcely developed vertical tubercle to occiput; on either side of this stripe, occupying sides of posterior vertex, a broad, diffuse, paler-brown area.

Pronotum buffy gray with a very delicate median brown dash. Mesonotal præscutum buffy with four conspicuous dark-brown stripes, cephalic ends of intermediate pair of stripes more pruinose; posterior interspaces obscured, lighter brown than stripes; lateral and humeral portions of præscutum broadly yellow, the latter including a more pruinose area on cephalic border immediately before lateral stripes; setæ of interspaces very short and sparse, pale; scutum with median portion dark brown, lobes gray, each with two separated, dark-brown areas; scutellum dark; mediotergite light gray, with a capillary, dark-brown, median vitta that narrows to a hairlike point before posterior margin. Pleura light ashy gray, ventral sternopleurite and anepisternum a trifle darker gray; dorsopleural membrane buffy yellow. Halteres relatively long, brownish black, base of stem restrictedly brownish yellow. Legs with coxæ light ashy gray; trochanters yellow; femora yellow, tips narrowly and gradually dark brown; tibiæ yellow, tips very narrowly infuscated; basal tarsal segments pale brown, narrowly tipped with darker; terminal segments brownish black. Wings (Plate 1, fig. 15) with a grayish tinge; prearcular field and cell Sc light yellow; stigma brownish yellow, its proximal end clear yellow; obliterative areas restricted; veins brown. Squama small, naked; veins beyond cord with sparse trichia, there being none on R₃ or any of the outer branches of M. Venation: Sc₁ preserved as

a vertical element; Sc_2 joining R_1 some distance before fork of Rs ; R_{1+2} entire; Rs long, a little less than twice long m-cu; cell 1st M_2 relatively large, inner end pointed; petiole of cell M_1 and m subequal; m-cu on M_4 some distance beyond fork of M_{3+4} ; base of M_4 perpendicular; cell 2d A relatively narrow.

Abdomen brownish yellow, with a broad, dark-brown, median stripe that is narrowly interrupted at the posterior borders of the segments which are testaceous yellow; sublateral stripes less distinct, lateral tergal borders light gray; sternites brown, surface, especially of outer segments, gray-pruinose. Ovipositor with cerci unusually long and slender, smooth, gently up-curved; hypovalvæ extending about to midlength of cerci, their tips obtusely rounded.

Habitat.—China (Fukien).

Holotype, female, Kuatun, altitude 2,500 to 3,000 meters, March 23, 1938 (*Klapperich*).

I am very uncertain as to the subgeneric position of the present fly. In the retention of vein Sc_1 it agrees with the otherwise very distinct *Brithura* Edwards; the long m-cu, with cell M_4 unusually wide at base, is a character of the otherwise entirely different *Schummelia* Edwards. In its general appearance it much more suggests an *Acutipula* Alexander or a *Lunatipula* Edwards, but the squama is without major setæ. The fly should be recognized readily by the diagnostic features listed above, and it is certain that the male sex, when discovered, will assist in more accurately placing the species in a subgeneric group.

NEPHROTOMA SINENSIS (Edwards).

Pachyrrhina sinensis EDWARDS, Ann. & Mag. Nat. Hist. VIII 18 (1916) 268, 269.

Kuatun, Fukien, altitude 2,500 to 3,000 meters, April 21, 1938 (*Klapperich*).

NEPHROTOMA IMPIGRA Alexander.

Nephrotoma impigra ALEXANDER, Philip. Journ. Sci. 57 (1935) 137, 138.

Kuatun, Fukien, altitude 2,500 to 3,000 meters, April 21, 1938 (*Klapperich*).

NEPHROTOMA GRAHAMIANA sp. nov. Plate 1, fig. 16; Plate 5, fig. 45.

General coloration yellow; præscutum with three polished, black stripes, lateral pair of stripes with an opaque black spot laterad of outer end; antennæ (male) relatively long, flagellar segments incised; occipital brand lacking; mesonotal scutellum

and mediotergite uniformly yellow; wings with a faint brown tinge, stigma darker brown; m-cu at or close to fork of M; male hypopygium with outer dististyle having posterior border conspicuously dilated; inner dististyle unusually massive, its dorsal crest elevated into a small flange; eighth sternite sheathing, submedian lobes with abundant, long, yellow setæ.

Male.—Length, about 13 to 14 millimeters; wing, 13 to 14; antennæ, about 6.

Frontal prolongation of head yellow, dorsal surface, including nasus, brownish black; palpi with basal segments brown, terminal two segments obscure brownish yellow. Antennæ (male) relatively elongate, as shown by measurements; scape relatively short, bright yellow; succeeding two segments yellow; intermediate flagellar segments bicolored, basal enlargement dark brown, remainder brownish yellow; outer flagellar segments uniformly brownish black; flagellar segments strongly incised, especially the more basal ones. Head orange-yellow without a differentiated occipital brand; vertical tubercle weakly notched.

Pronotum yellow. Mesonotal præscutum yellow with three polished, black stripes, lateral pair of stripes with outcurved, opaque, black spots at anterior ends, these ends not reaching margin of sclerite; remainder of stripes very narrowly and insensibly bordered by velvety black; scutum yellow, each lobe with two confluent, polished, black areas, lateral portion of transverse suture opaque black; scutellum and postnotum uniformly yellow. Pleura yellow, more reddish yellow on ventral sternopleurite and ventral anepisternum. Halteres brown, base of stem and apex of knob obscure yellow. Legs yellow, outer tarsal segments passing into brown. Wings (Plate 1, fig. 16) with a very faint brown tinge, prearcular field and cell Sc more yellowish; stigma brown, conspicuous; veins brown. Venation: Sc₂ ending opposite origin of Rs; cell M₁ sessile; m-cu at fork of M or virtually so.

Abdominal tergites yellow, with a broad, black, median stripe that is narrowly interrupted at posterior borders of segments, lateral portions of segments less evidently darkened; sternites yellow; segments seven to nine, inclusive, intensely black. Male hypopygium (Plate 5, fig. 45) with ninth tergite, 9*t*, black, lateral spines or lobes relatively short; caudal margin with a U-shaped median notch, sublateral lobes with unusually numerous blackened spines; median area behind emargination filled with whitish membrane. Outer dististyle, *od*, moderately attenuated, posterior border widely dilated. Inner dististyle, *id*,

unusually massive, posterior portion of dorsal crest elevated into a small, triangular flange; beak moderately slender, not heavily blackened. Gonapophyses, *g*, short and compressed, tips obtusely rounded. Eighth sternite sheathing, median area filled with pale membrane, lateral lobes with abundant long, yellow setæ.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Shuang Fei Chiao (Flying Bridges Temple), altitude 3,000 feet, June 14, 1935 (*Graham*). Paratopotypes, 5 males, June 14 to 23, 1935.

Nephrotoma grahamiana is named in honor of the Reverend Mr. David C. Graham, who has sent vast collections of zoological specimens from Szechwan and the Tibet Border to the United States National Museum. The fly is readily told from the other regional species by the pattern of the mesonotum, especially the præscutum, scutellum, and mediotergite. The structure of the male hypopygium, especially of the inner dististyle, is distinctive of the species.

NEPHROTOMA AURANTIOCINCTA sp. nov. Plate 1, fig. 17; Plate 5, fig. 46.

General coloration black, abdominal segments four and five abruptly orange; antennæ, legs, and halteres black; wings with a very strong blackish tinge; male hypopygium with apical beak of inner dististyle slender; a very high, glabrous, posterior, dorsal crest.

Male.—Length, about 15 millimeters; wing, 14; antennæ, about 5.

Female.—Length, about 18 to 19 millimeters; wing, 14 to 15.

Frontal prolongation of head black; nasus long and slender; palpi black. Antennæ black throughout, longer in male; basal flagellar segments rather strongly incised, outer segments less evidently so; verticils shorter than segments. Head uniformly dull black; vertical tubercle relatively conspicuous; occipital brand not evident.

Mesonotal præscutum with ground dull blackish gray throughout, almost covered by three blackish stripes that are poorly indicated against the ground; remainder of notum dull black except for median area of scutum and base of scutellum. Pleura uniformly dull black, sparsely pruinose. Halteres black, base of stem restrictively paler. Legs with coxæ black, sparsely pruinose; remainder of legs black, tibiæ a very little paler. Wings (Plate 1, fig. 17) with a very strong blackish tinge, prearcular and costal regions, together with stigma, darker; cells distad of cord a trifle paler than proximal portion of wing; veins brownish

black. Venation: Sc_2 ending about opposite one-third length of R_s , Sc_1 represented by a short spur; m-cu at or just beyond fork of M , M_{3+4} thus very short or obliterated; cell M_1 sessile.

Abdomen opaque velvety black; a broad, orange ring including all of segments four and five and, in cases, posterior portion of segment three; genital shield of female black, cerci paler; male hypopygium black. Male hypopygium (Plate 5, fig. 46) with ninth tergite, 9t, with caudal margin transverse, notched medially, lobes with abundant blackened, spinous points; on ventral surface a further armature consisting of a bilobed structure, inner arm a spine, outer arm terminating in three or four small, obtuse points. Margin of basistyle below point of insertion of dististyles with a conspicuous, blackened plate, the surface of which is microscopically roughened. Outer dististyle, *od*, moderately attenuated. Inner dististyle, *id*, with apical beak slender; posterior dorsal crest very high and glabrous. Gonapophyses, *g*, appearing as very small glabrous blades, at base nearly as wide as long, apex obtusely rounded. Eighth sternite, 8s, deeply emarginate, notch filled with pale membrane, entire median area provided with abundant long, dark setæ.

Habitat.—China (Szechwan).

Holotype, male, Mount Omei, Shuang Fei Chiao (Flying Bridges Temple), altitude 3,000 feet, June 14, 1935 (Graham). Allotopotype, female, June 22, 1935. Paratopotype, female, June 22, 1935. Paratopotype, female, with the holotype.

Nephrotoma aurantiocincta is quite distinct from all described regional species of the genus. It is most similar to the Formosan *N. takeuchii* Alexander which differs in the different position of the orange abdominal band and in other features. Both of these flies bear a superficial resemblance to species of the genus *Tipula* belonging to the subgenus *Formotipula* Matsumura.

DOLICHOPEZA (OROPEZA) CANDIDIPE (Alexander).

Oropeza candidipes ALEXANDER, Ann. Ent. Soc. America 14 (1921) 122.

Widely distributed in the main island of Japan.

HONSHIU, Hinoemata, Iwashiro, July 24, 1923 (*Esaki*); Tamagawa, Musashi, August 30, 1920; August 22 to September 7, 1922 (*Machida*); Chichibu, Nakatsugawa, Musashi, August 24, 1930 (*Machida*); Mount Ohdai, Yamato, June 5, 1930 (*Sakaguchi*); Mount Minomo, Settsu, June 22, 1922 (*Esaki*); Saga, Yamashiro, altitude 490 feet, May 1927 (*Tokunaga*); Mount

Daisen, Hoki, altitude 2,600 feet, June 7, 1930 (*Hibi*); this specimen with cell M_2 of wings open by atrophy of m ; Mount Kyusho, Hoki, altitude 860 feet, June 13, 1930 (*Hibi*).

DOLICHOPEZA (OROPEZA) SAITAMENSIS Alexander.

Dolichopeza (Oropeza) saitimensis ALEXANDER, Philip. Journ. Sci. 43 (1930) 510, 511.

KARAFUTO, Toyohara, July 16, 1922 (Esaki). HOKKAIDO, Kamiotoineppu, August 23, 1922 (Esaki).

DOLICHOPEZA (OROPEZA) SATSUMA (Alexander).

Oropeza satsuma ALEXANDER, Journ. N. Y. Ent. Soc. 26 (1918) 67.

HONSHIU, Mount Ibuki, Mino, June 4, 1921 (*Takeuchi*); Kyoto, Yamashiro, September 20, 1923 (*Takeuchi*); Shirokita-mura, Settsu, July 10, 1924 (*Teranishi*).

DOLICHOPEZA (NESOPEZA) ALBITIBIA (Alexander).

Nesopeza albitibia ALEXANDER, Insec. Inscit. Menst. 10 (1922) 187, 188.

HONSHIU, Chuzenji, Shimotsuke, altitude 4,800 feet, July 22, 1923 (*Esaki*); Mount Ohdai, Yamato, June 5, 1930 (*Sakaguchi*); Saga, Yamashiro, altitude 490 feet, July 27, 1929 (*Tokunaga*); Mount Daisen, Hoki, altitude 4,550 feet, June 7, 1930 (*Hibi*); Mount Kyusho, Hoki, altitude 860 feet, June 13, 1930 (*Hibi*). KIUSHIU, Wakasugiyama, Chikuzen, May 28 and 29, 1931 (*Esaki & Hori*).

DOLICHOPEZA (NESOPEZA) GENICULATA (Alexander).

Nesopeza geniculata ALEXANDER, Ann. Ent. Soc. America 11 (1918) 448.

HOKKAIDO, Jozankei, Ishikari, altitude 1,000 feet, August 16, 1923 (*Esaki*). HONSHIU, Mount Shirouma (*Hakuba*), Shinano, August 8 and 9, 1931 (*Machida*). Mount Minomo, Settsu, June 22, 1922 (*Esaki*). KIUSHIU, Kagoshima, Satsuma (*Esaki*).

DOLICHOPEZA (NESOPEZA) TARSALIS (Alexander).

Nesopeza tarsalis ALEXANDER, Ann. Ent. Soc. America 12 (1919) 347.

HONSHIU, Mount Kiyozumi, Boso Peninsula, Kazusa, altitude 1,035 feet, May 5, 1931 (*Oda*); Saga, Yamashiro, altitude 490 feet, July 27, 1929 (*Tokunaga*).

CYLINDROTOMINÆ

TRIOGMA NIMBIPENNIS sp. nov. Plate 1, fig. 18; Plate 5, fig. 47.

General coloration dark gray; wings with a strong brown tinge, long-oval stigma dark brown, conspicuous; fusion of

R_{4+5} on M_{1+2} variable, from punctiform to extensive; male hypopygium with lateral lobes of tergite slender, earlike.

Male.—Length, about 14 to 15 millimeters; wing, 11 to 12; antennæ, about 4 to 4.2.

Female.—Length, about 13 to 14 millimeters; wing, 12 to 12.5.

Rostrum gray; palpi black. Antennæ of male relatively long, of female of moderate length, black throughout; flagellar segments (male) triangularly produced, each with a short glabrous basal pedicel. Head brownish gray, clearer gray on wide anterior vertex; posterior vertex longitudinally furrowed but without circular punctures.

Mesonotum opaque, dark brown, surface sparsely pruinose; præscutal interspaces deeply grooved and furrowed, clearly delimiting stripes. Pleura opaque brownish gray, dorsopleural membrane more buffy. Halteres infuscated, stem paler, its base narrowly yellow. Legs with coxæ gray pruinose; trochanters brownish yellow; remainder of legs chiefly brownish black, femoral bases obscure yellow, involving approximately basal half or less, least extensive on forelegs; tibial bases restrictedly brightened. Wings (Plate 1, fig. 18) with a strong brown tinge, long-oval stigma dark brown, conspicuous; veins brown. Venation: Sc_1 preserved except at tip; R_{2+3} arcuated below stigma; fusion of R_{4+5} and M_{1+2} punctiform to extensive, in rare cases, r-m present as a short element.

Abdomen elongate, especially in male, blackish gray, including genitalia. Male hypopygium with lateral lobes of tergite (Plate 5, fig. 47, 9t) produced into long, slender ears. Dististyle, *d*, simple, only a little narrower on distal half than at base. *Ædeagus* much as in *kuwanai*, protruding conspicuously from the genital chamber.

Habitat.—China (Fukien, Chekiang).

Holotype, male, Kuatun, Fukien, altitude 2,500 to 3,000 meters, March 25, 1938 (*Klapperich*). Allotopotype, female, March 27, 1938. Paratopotypes, 5 males and females, March 23 to 29, 1938. Paratype, 1 male, Mogan Shan, Chekiang, April 24, 1936 (*Piel*); Museum Heude, Shanghai.

Triogma nimbipennis is very closely allied to the Japanese *T. kuwanai* (Alexander), differing especially in slight details of coloration, especially the darkened wings with a very conspicuous, dark-brown stigma. It is possible that the present fly will eventually be considered as being a subspecies of *kuwanai*. The genus *Triogma* Schiner had not been recorded from China hitherto.

LIMONIINÆ

LIMONIINI

LIMONIA (LIMONIA) WHITEÆ sp. nov. Plate 1, fig. 19; Plate 5, fig. 48.

General coloration yellow, variegated with brownish black; antennæ black throughout, flagellar segments with short, glabrous, apical necks; anterior vertex very broad; mesonotal præscutum with a blackened shield that sends an arm to the lateral margin behind the pseudosutural foveæ; a broken, transverse, black girdle on mesepisternum; legs black, at least posterior tarsi snowy white; wings with a strong blackish tinge, oval stigma darker brown; Sc long, free tip of Sc₂ lying a short distance before level of R₂; m-cu shortly before fork of M; abdominal segments black, caudal margins broadly yellow; male hypopygium with a single rostral spine, arising from a long, basal tubercle; gonapophyses blackened, broad mesal-apical lobes hispinous.

Male.—Length, about 6 millimeters; wing, 6.4.

Rostrum and palpi black. Antennæ black throughout; flagellar segments passing through oval to long-oval, with short, glabrous, apical necks that become longer and more constricted on outer segments. Head black, possibly pruinose in fresh specimens, discolored in unique type; anterior vertex very broad, nearly three times as wide as diameter of scape.

Pronotum brown. Mesonotal præscutum with restricted ground color obscure brownish yellow; posterior portion of disc covered by a blackened shield composed of usual three stripes that are entirely confluent, sending a lateral extension to margin, leaving a pale lateral area before suture; scutal lobes black, median area paler; scutellum pale; mediotergite pale brownish yellow, each cephalic lateral angle with major blackened areas; pleurotergite blackened. Pleura yellow, including propleura, pteropleurite, and meron; major black areas on anepisternum and ventral sternopleurite, forming a slightly interrupted transverse girdle. Halteres brownish black. Legs with all coxæ and trochanters yellow; remainder of legs black, outer tarsal segments of at least hind legs snowy white; other legs broken beyond tibæ. Wings (Plate 1, fig. 19) with a strong, blackish tinge, prearcular and costal fields a very little darker; stigma oval, darker brown; veins dark brown. Venation: Sc long, Sc₁ ending about opposite three-fifths length of Rs, Sc₂ a short distance from its tip; free tip of Sc₂ lying a short distance before level of R₂; R₁₊₂ preserved as a short spur; m-cu shortly before fork of M.

Abdomen conspicuously ringed with black and pale yellow; segments chiefly black with about distal third yellow; outer segments, including hypopygium, more uniformly blackened. Male hypopygium (Plate 5, fig. 48) with tergite, 9t, transverse, caudal margin gently and convexly rounded, thickened. Dorsal dististyle a gently curved, blackened sickle. Ventral dististyle, vd, small and rounded, its area less than one-half that of basistyle; rostral prolongation slender, cylindrical, bearing a single long, straight spine from a long, basal tubercle; spine nearly twice length of tubercle which is placed near extreme outer end of prolongation, latter terminating in an acute spine. Gonapophysis, g, with mesal-apical lobe broad, blackened, conspicuously bispinous. Apex of ædeagus bilobed.

Habitat.—India (Madras Presidency).

Holotype, male, Manamadura, 1939 (*Laura White*). Received through the friendly interest of Mr. George E. Erikson.

Limonia (*Limonia*) *whitex* is named in honor of the collector. Although the legs of the unique type are partly broken I would believe that this fly might afford a case comparable to *L. (L.) longivena* (Edwards) where only the posterior tarsi are white, the others being concolorous with the darkened tibiæ and femora. The rostral spines of the male hypopygium somewhat resemble the condition found in the East Indian *L. (L.) albitarsis* Alexander, an entirely distinct fly in all other regards. *L. (L.) palniensis* Alexander has the pattern of the wings and abdomen somewhat similar to that of the present fly, but the coloration of the body and legs is different.

PEDICIINI

PEDICIA (PEDICIA) SUBFALCATA sp. nov. Plate 1, fig. 20.

General coloration of mesonotal præscutum silvery yellow, with a single, brown, median stripe; fore femora blackened, posterior femora obscure yellow with only the distal sixth blackened; wings strongly subfalcate in outline, whitish subhyaline, with a conspicuous dark pattern; origin of Rs and cord with veins pale, adjoining membrane light yellow; a whitish spot in base of cell R_2 beyond vein R_2 ; cell M_1 short-petiolate; abdominal tergites with a brown median area, bordered sublaterally by brownish-black, lateral triangles broadly silvery gray.

Female.—Length, about 32 millimeters; wing, 27.

Frontal prolongation of head dark gray; palpi black. Antennæ 15-segmented; scape and pedicel black, flagellum dark

brown; flagellar segments with verticils unilaterally distributed. Head dark gray, anterior vertex blackened; central portion of posterior vertex with a linear blackened streak; vertical tubercle small, without a circular depressed area.

Pronotum brownish black, scutum deep orange on either side of midline. Mesonotal præscutum silvery yellow, with a single, broad and conspicuous, median, dark-brown stripe, usual lateral stripes scarcely differentiated from ground; scutal lobes brown, median area paler; scutellum whitish gray with a brown central spot; mediotergite brownish gray, more silvery white in front, with a blackened median stripe. Pleura silvery yellow, pleurotergite more infuscated. Halteres with stem yellow, knob infuscated. Legs with coxæ brownish gray; trochanters dark brown; femora black, bases obscure yellow, most restricted on forelegs where only extreme base is brightened; posterior femora chiefly obscure yellow with about distal sixth blackened; tibiæ and tarsi brownish black. Wings (Plate 1, fig. 20) strongly subfalcate in outline, tip in cell R_4 strongly produced; whitish subhyaline with usual pattern of subgenus; cell C much paler, especially on basal portion where it is virtually clear; base of R_s and cord with veins and adjoining membrane pale, abruptly contrasting with dark pattern; two isolated clear spots, one in cell R, before vein R_2 , the other in base of cell R_2 ; dark seam along vein Cu broadly reaching wing margin and expanded backward at tip to beyond 1st A; dark areas in outer radial field much paler brown than seam along cord vein R_4 ; veins pale. Venation: R_s oblique at origin, thence straight; cell 1st M_2 short-subquadrate; cell M_1 very short-petiolate.

Abdominal tergites brown medially, bordered sublaterally by brownish black, leaving silvery-gray lateral borders that are widened posteriorly, narrowed to a point at cephalic margin of each segment; sternites brownish gray, darkened posteriorly, lateral borders broadly silvery gray, nearly parallel-sided; cerci short and relatively deep.

Habitat.—China (Fukien).

Holotype, female, Kuatun, altitude 2,500 to 3,000 meters, March 29, 1938 (*Klapperich*).

Pedicia (*Pedicia*) *subfalcata* is most generally similar to *P. (P.) gifuensis* Kariya, of Japan, which has the wing of normal outline, not subfalcate, and with the coloration of the thorax, wings, and abdomen quite distinct. The present is the first record of the subgenus *Pedicia* Latreille in China.

PEDICIA (TRICYPHONA) ELEGANS INVARIPIES subsp. nov.

Female.—Length, about 7 millimeters; wing, 7.

Rostrum and palpi pale. Antennæ 15-segmented, pale brown, basal flagellar segments enlarged. Head ochreous.

Mesonotum grayish ochreous, præscutum with four scarcely evident darker stripes; scutal lobes weakly darkened, median area, scutellum, and postnotum pale yellow. Pleura weakly infumed, especially mesepisternum. Halteres pale yellow, knob dark brown. Legs pale yellow, outer tarsal segments weakly darkened; no sign of dark color at tips of femora and tibiæ. Wings ochreous, with a spare, pale-brown pattern, as follows: Origin of Rs; cord; outer end of cell 1st M_2 ; forks of R_{4+5} and M_{1+2} ; small marginal clouds at ends of longitudinal veins, none conspicuously enlarged; stigma with pale centers, encircled by a brown ring, ends delimited by tip of vein Sc_1 and R_2 ; veins yellow, darker in clouded areas. Venation: Rs long, angulated at origin; r-m connecting with R_{4+5} a short distance beyond origin; R_2 transverse, shorter than R_{1+2} ; cell 1st M_2 closed; m-cu shortly beyond fork of M.

Abdomen with tergites yellow, basal rings narrowly darkened; sternites more uniformly yellow, lateral margins narrowly dark.

Habitat.—Assam (Khasi Hills).

Holotype, female, Cherrapunji, altitude 4,000 feet, May 1937 (*Sircar*).

Close to typical form (Kurseong, Himalayas), legs with femora and tibiæ entirely pale, with no indications of darkened tips; wings with stigma ringed, with pale center; outer end of cell 1st M_2 nearly truncate, not strongly pointed, as in typical form.

HEXATOMINI

LIMNOPHILA FOKIENSIS sp. nov. Plate 1, fig. 21.

General coloration polished black, pleura pruinose; antennæ (male) elongate, black throughout; wings with a weak brown tinge, sparsely patterned with slightly darker brown; cell M_1 lacking; m-cu beyond midlength of lower face of cell 1st M_2 .

Male.—Wing, 7.6 millimeters; antennæ, about 3.6.

Rostrum and palpi black. Antennæ (male) elongate, nearly one-half length of wing, black throughout; flagellar segments elongate, slightly fusiform with truncated ends, greatest diameter just before midlength; verticils shorter than segments; a coarse, erect, pale pubescence over entire segment, setæ about

one-half as long as verticils; terminal segment about one-third length of penultimate. Head black, sparsely pruinose; anterior vertex broad, with a low tubercle.

Thorax uniformly black, surface polished, median area of scutum and base of scutellum more heavily pruinose. Pleura black, heavily pruinose. Halteres pale yellow, knobs very weakly infuscated. Legs with coxæ and trochanters black, pruinose; remainder of legs black, femoral bases restrictedly paler; femora with short, delicate setæ. Wings (Plate 1, fig. 21) with a weak brown tinge, prearcular and costal regions slightly brighter; stigma and weak seams at origin of Rs, along cord and outer end of cell 1st M_2 , and in cell Cu slightly darker brown; veins brown, brighter in prearcular field. Venation: Sc_1 ending shortly before fork of R_{2+3+4} , Sc_2 shortly before fork of Rs; R_2 very faint, about one-half as long as R_{1+2} ; R_{2+3+4} a little longer than basal section of R_5 ; cell M_1 lacking; m-cu beyond midlength of lower face of cell 1st M_2 ; anterior arcus preserved.

Abdomen black, broken beyond fifth segment.

Habitat.—China (Fukien).

Holotype, male, Kuatun, altitude 2,500 to 3,000 meters, March 25, 1938 (*Klapperich*).

Limnophila fokiensis appears to belong to the subgenus *Priornolabis* Osten Sacken, differing from all regional species in the venation and pattern of the wings, and especially in the elongate antennæ which are nearly one-half as long as the wing and with a somewhat peculiar vestiture. Unfortunately the tip of the abdomen was lacking on the unique type specimen.

LIMNOPHILA (ADELPHOMYIA) REDUCTANA sp. nov. Plate 1, fig. 22.

General coloration of mesonotum and pleura black, heavily pruinose to appear dark gray, præscutum without stripes; basal antennal segments pale brown; femora obscure yellow, tips weakly infuscated; wings brownish yellow, prearcular and costal portions clearer yellow; a restricted brown pattern, especially along cord and vein Cu; R_{2+3+4} very short; r-m strongly arcuated; abdomen black, sparsely pruinose, basal sternites paler.

Female.—Length, about 8.5 millimeters; wing, 8.2.

Rostrum black, sparsely pruinose; palpi black. Antennæ with basal flagellar segments pale brown; outer flagellar segments darker; flagellar segments long-oval, with verticils that exceed segments in length. Head dark gray.

Mesonotum almost uniform dark gray, without distinct stripes, the median region of præscutum a little more blackened, un-

polished. Pleura black, pruinose. Halteres yellow, apex of knob weakly darkened. Legs with fore coxæ brownish black; midcoxæ yellow, weakly darkened on basal portion; posterior coxæ yellow; trochanters yellow; femora obscure yellow, tips weakly infuscated; tibiæ and basal two tarsal segments pale brown, their apices very restrictedly darkened; outer tarsal segments brownish black. Wings (Plate 1, fig. 22) brownish yellow, prearcular and costal fields clearer yellow; stigma brown; more diffuse brown seams at origin of R_s , along cord and outer end of cell 1st M_2 and along vein Cu; veins brown, pale yellow in flavous basal portions. Very sparse macrotrichia in outer ends of cells R_3 to M_1 , inclusive. Venation R_{2+3+4} very short, about one-half basal section of R_5 , cell R_3 thus short-petiolate; r-m strongly arcuated; cell M_1 nearly twice its petiole; m-cu about one-half its length beyond fork of M.

Abdomen black, sparsely pruinose; basal sternites obscure brownish yellow; bases of cerci and hypoalvæ blackened, remainder horn-yellow.

Habitat.—China (Fukien).

Holotype, female, Kuatun, altitude 2,500 to 3,000 meters, March 28, 1938 (*Klapperich*).

Limnophila (*Adelphiomyia*) *reductana* is most similar to species such as the Japanese *L. (A.) pilifer* Alexander, differing most evidently in the great reduction in number of trichia in the cells of the wing, as well as in the wing pattern and venation.

HEXATOMA (ERIOCERA) PYRRHOPYGA Alexander.

Hexatoma (Eriocera) pyrrhopyga ALEXANDER, Philip. Journ. Sci. 52 (1933) 162, 163.

ANHWEL, CHINA, Taipinghsien, October 1932 (*Liu*); collectors No. 755.

HEXATOMA (ERIOCERA) REGINA Alexander.

Hexatoma (Eriocera) regina ALEXANDER, Notes d'Ent. Chinoise, Mus. Heude 4 fasc. 5 (1937) 82-84.

ANHWEL, CHINA, Taipinghsien, October 1922 (*Liu*); collector's No. 766.

HEXATOMA (ERIOCERA) REGINA KIUHUANA subsp. nov.

As in typical form, differing as follows: femora extensively yellow, in all legs broken at near one-third length but probably with only tips darkened. Wings with a large, pale area in cell Cu at near midlength. Abdomen with segments two to four

chiefly reddish orange, narrowly margined with blackish. Genital shield orange. Mesonotum opaque, as in typical *regina*.

It is probable that better-preserved material will give this fly full specific ranking.

Holotype, female, Kiuhua-shan, Anhwei, China, September 1932 (*Liu*); collector's No. 754. Paratopotype, sex?; No. 759.

ERIOPTERINI

SIGMATOMERA (AUSTROLIMNOBIA) RARISSIMA sp. nov. Plate 1, fig. 23; Plate 5, fig. 49.

General coloration of mesonotum and propleura orange, parascutella, pleurotergite, and remainder of pleura abruptly black; anterior vertex polished black, posterior of head more plumbeous; antennæ (male) elongate, black throughout; flagellar segments long-cylindrical; legs black, fore coxæ and trochanters, with base of fore femora yellow; wings pale yellow, heavily patterned with black, including prearcular and costal regions, and more or less complete bands at origin of Rs and along cord; wing tip broadly darkened; cell 1st M_2 longer than any of veins beyond it; abdominal tergites orange, first black; tergites five and six, together with all sternites beyond the basal sternite, with blackened caudal borders; subterminal segments uniformly blackened, hypopygium yellow; male hypopygium with caudal margin of tergite with a very deep V-shaped notch; inner dististyle with smooth margins.

Male.—Length, about 17 millimeters; wing, 13; antennæ about 8.5.

Rostrum and palpi black. Antennæ (male) black throughout, elongate, equal to one-half length of body; flagellar segments cylindrical, with abundant coarse, erect pubescence that exceeds scattered verticils in length; terminal segment small, less than one-fourth as long as penultimate. Head polished black, posterior vertex more plumbeous; anterior vertex a little narrower than diameter of scape, eyes correspondingly enlarged.

Pronotum orange. Mesonotum orange, unmarked, only parascutella and pleurotergite abruptly black. Propleura orange, remainder of pleura abruptly black. Halteres black throughout. Legs with fore coxæ and trochanters orange; middle and hind coxæ and trochanters black; fore femora black, bases narrowly yellow; remaining femora entirely black; tibiæ and tarsi black. Wings (Plate 1, fig. 23) with ground color pale yellow, very heavily patterned with brownish black, the latter including prearcular field, cells C and Sc, stigma, and major areas on

disc, as follows: Narrow bases of cells R and M; a posterior extension at origin of Rs, extending caudad to beyond midwidth of cell M and not quite reaching extensive dark clouds in outer ends of cells Cu, 1st A, and 2d A; a complete but relatively narrow dark crossband at cord; wing tip broadly blackened, extending basad to level of R_2 and shortly before outer end of cell 1st M_2 ; veins yellow in ground areas, abruptly dark brown in darkened portions. Venation: Rs of moderate length, arcuated at origin, in longitudinal alignment with short basal section of vein R_5 ; R_{2+3+4} relatively short and strongly arcuated; cell 1st M_2 long, exceeding in length any of the veins issuing from it; m-cu erect, shortly beyond fork of M.

Abdomen with basal segment black, caudal border of sternite narrowly yellow; tergites two to four, inclusive, uniform orange-yellow; tergites five and six orange with narrow, black caudal borders; segments seven and eight uniformly black; sternites yellow, caudal borders of all segments beyond first conspicuously black; hypopygium yellow. Male hypopygium (Plate 5, fig. 49) with caudal margin of tergite, 9t, with a very deep V-shaped notch, lateral lobes thus formed relatively narrow and widely separated. Outer dististyle small and pointed. Inner dististyle, *id*, with margins entirely smooth, apex of elongate rostrum subtruncate.

Habitat.—North Queensland.

Holotype, male, Prince of Wales Island, February 17, 1939 (R. G. Wind).

Sigmatomera (*Austrolimnobia*) *rarissima* is a fly of unusual beauty and distinctness. It is so different from the other Australian species so far known that any comparison is unnecessary. The discovery of this new species makes it appear very doubtful that *Astelobia* Edwards (1923) can be maintained as distinct from *Austrolimnobia* Alexander (1922).

MOLOPHILUS (MOLOPHILUS) KIUSHIENSIS sp. nov. Plate 1, fig. 24; Plate 5, fig. 50.

Belongs to the *gracilis* group and subgroup; general coloration polished black; halteres pale yellow; legs dark brown, femoral bases restrictedly obscure yellow; wings with a weak brown tinge; male hypopygium with longest dististyle appearing as a flattened, sinuous blade, apex truncate and irregularly toothed, face of blade at near midlength with about 15 to 18 erect, acute spines.

Male.—Length, about 3.5 to 3.6 millimeters; wing, 4.3 to 4.5.

Female.—Length, about 5 millimeters; wing, 5.

Rostrum and palpi black. Antennæ with scape and pedicel black, flagellar segments oval. Head black, sparsely pruinose.

Mesonotum uniformly polished black. Halteres pale yellow. Legs with coxæ black; trochanters yellow; remainder of legs dark brown, femoral bases restrictedly obscure yellow. Wings (Plate 1, fig. 24) with a weak brown tinge, prearcular and costal fields more yellowish; veins pale brown, yellow in brightened portions; macrotrichia dark brown. Venation: R_2 lying just proximad of level of r-m; petiole of cell nearly twice m-cu; vein 2d A of moderate length, ending nearly opposite posterior end of m-cu.

Abdomen, including hypopygium, intense black. Male hypopygium (Plate 5, fig. 50) with dorsal lobe of basistyle, *db*, relatively slender, with long setæ to very apex; mesal lobe, *mb*, low, armed with about a score of short, blackened points. Outer dististyle, *od*, longest, appearing as a flattened sinuous blade, apex truncated and irregularly toothed; on face of blade at near midlength with about 15 to 18 erect, acute spines, with one or two similar spines lying more distad. Inner dististyle, *id*, small, appearing as a flattened blade, tip acute, before apex with microscopic spinulæ.

Habitat.—Japan (Kiushiu).

Holotype, male, Fugandake, altitude 2,500 to 4,360 feet, at end of May 1922 (J. E. A. Lewis); in the Dietz Collection, Academy of Natural Sciences, Philadelphia. Allotopotype, female. Paratopotype, 1 male, 1 broken.

Molophilus (*Molophilus*) *kiushiuensis* is readily told from all other polished black species with unvariegated legs by the structure of the male hypopygium, especially the styli.

ILLUSTRATIONS

[Legend: *a*, ædeagus; *b*, basistyle; *d*, dististyle; *db*, dorsal lobe of basistyle; *g*, gonapophysis; *id*, inner dististyle; *mb*, mesal lobe of basistyle; *od*, outer dististyle; *s*, sternites; *t*, tergites; *vd*, ventral dististyle.]

PLATE 1

- FIG. 1. *Pselliophora scurra* sp. nov.; venation.
 2. *Tanyptera subcognata* sp. nov.; venation.
 3. *Dictenidia stalactitica* sp. nov.; venation.
 4. *Ctenacroscelis goliath* sp. nov.; venation.
 5. *Tipula* (*Nippotipula*) *klapperichi* sp. nov.; venation.
 6. *Tipula* (*Formotipula*) *spoliatrix* sp. nov.; venation.
 7. *Tipula* (*Acutipula*) *luteinotalis* sp. nov.; venation.
 8. *Tipula* (*Acutipula*) *bihastata* sp. nov.; venation.
 9. *Tipula* (*Acutipula*) *stenoterga* sp. nov.; venation.
 10. *Tipula* (*Vestiplex*) *cremeri* sp. nov.; venation.
 11. *Tipula* (*Oreomyza*) *liui* sp. nov.; venation.
 12. *Tipula* (*Oreomyza*) *kuatunensis* sp. nov.; venation.
 13. *Tipula* (*Lunatipula*) *furiosa* sp. nov.; venation.
 14. *Tipula parvaurecula* sp. nov.; venation.
 15. *Tipula reservata* sp. nov.; venation.
 16. *Nephrotoma grahamiana* sp. nov.; venation.
 17. *Nephrotoma aurantiocincta* sp. nov.; venation.
 18. *Triogma nimbipennis* sp. nov.; venation.
 19. *Limonia* (*Limonia*) *whiteæ* sp. nov.; venation.
 20. *Pedicia* (*Pedicia*) *subfalcata* sp. nov.; venation.
 21. *Limnophila fokiensis* sp. nov.; venation.
 22. *Limnophila* (*Adelphomyia*) *reductana* sp. nov.; venation.
 23. *Sigmatomera* (*Austrolimnobia*) *rarissima* sp. nov.; venation.
 24. *Molophilus* (*Molophilus*) *kiushiuensis* sp. nov.; venation.

PLATE 2

- FIG. 25. *Pselliophora scurra* sp. nov.; male hypopygium, details.
 26. *Tanyptera subcognata* sp. nov.; male hypopygium, dististyles.
 27. *Dictenidia stalactitica* sp. nov.; antenna, male.
 28. *Dictenidia stalactitica* sp. nov.; male hypopygium, lateral.
 29. *Dictenidia stalactitica* sp. nov.; male hypopygium, details.
 30. *Dictenidia glabrata* Alexander; male hypopygium, details.
 31. *Plocimas magnificus* Enderlein; male hypopygium, details.

PLATE 3

- FIG. 32. *Ctenacroscelis herculeanus* sp. nov.; male hypopygium, details.
 33. *Ctenacroscelis goliath* sp. nov.; male hypopygium, details.
 34. *Tipula* (*Formotipula*) *spoliatrix* sp. nov.; male hypopygium, details.

35. *Tipula* (*Acutipula*) *luteinotalis* sp. nov.; male hypopygium, ninth tergite.
36. *Tipula* (*Acutipula*) *luteinotalis* sp. nov.; male hypopygium, dististyles.
37. *Tipula* (*Acutipula*) *bihastata* sp. nov.; male hypopygium, ninth tergite.
38. *Tipula* (*Acutipula*) *bihastata* sp. nov.; male hypopygium, inner dististyle.

PLATE 4

- FIG. 39. *Tipula* (*Acutipula*) *stenoterga* sp. nov.; male hypopygium, details.
40. *Tipula* (*Oreomyza*) *liui* sp. nov.; male hypopygium, details.
 41. *Tipula* (*Oreomyza*) *kuatunensis* sp. nov.; male hypopygium, details.
 42. *Tipula* (*Oreomyza*) *kuatunensis* sp. nov.; male hypopygium, dististyles.
 43. *Tipula* (*Lunatipula*) *furiosa* sp. nov.; male hypopygium, details.
 44. *Tipula* *parvaurecula* sp. nov.; male hypopygium, details.

PLATE 5

- FIG. 45. *Nephrotoma grahamiana* sp. nov.; male hypopygium, details.
46. *Nephrotoma aurantiocincta* sp. nov.; male hypopygium, details.
 47. *Triogma nimbipennis* sp. nov.; male hypopygium, details.
 48. *Limonia* (*Limonia*) *whiteæ* sp. nov.; male hypopygium.
 49. *Sigmatomera* (*Austrolimnobia*) *rarissima* sp. nov.; male hypopygium.
 50. *Molophilus* (*Molophilus*) *kiushiensis* sp. nov.; male hypopygium.

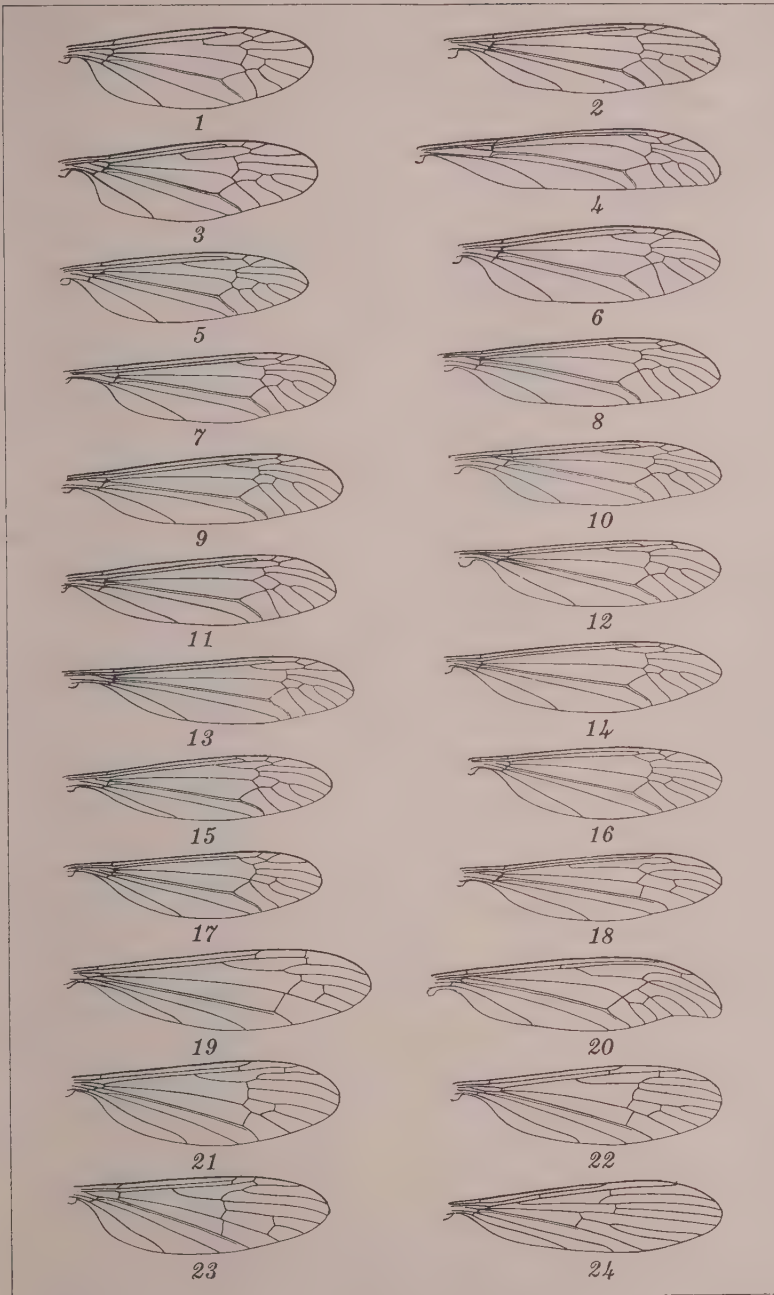


PLATE 1.

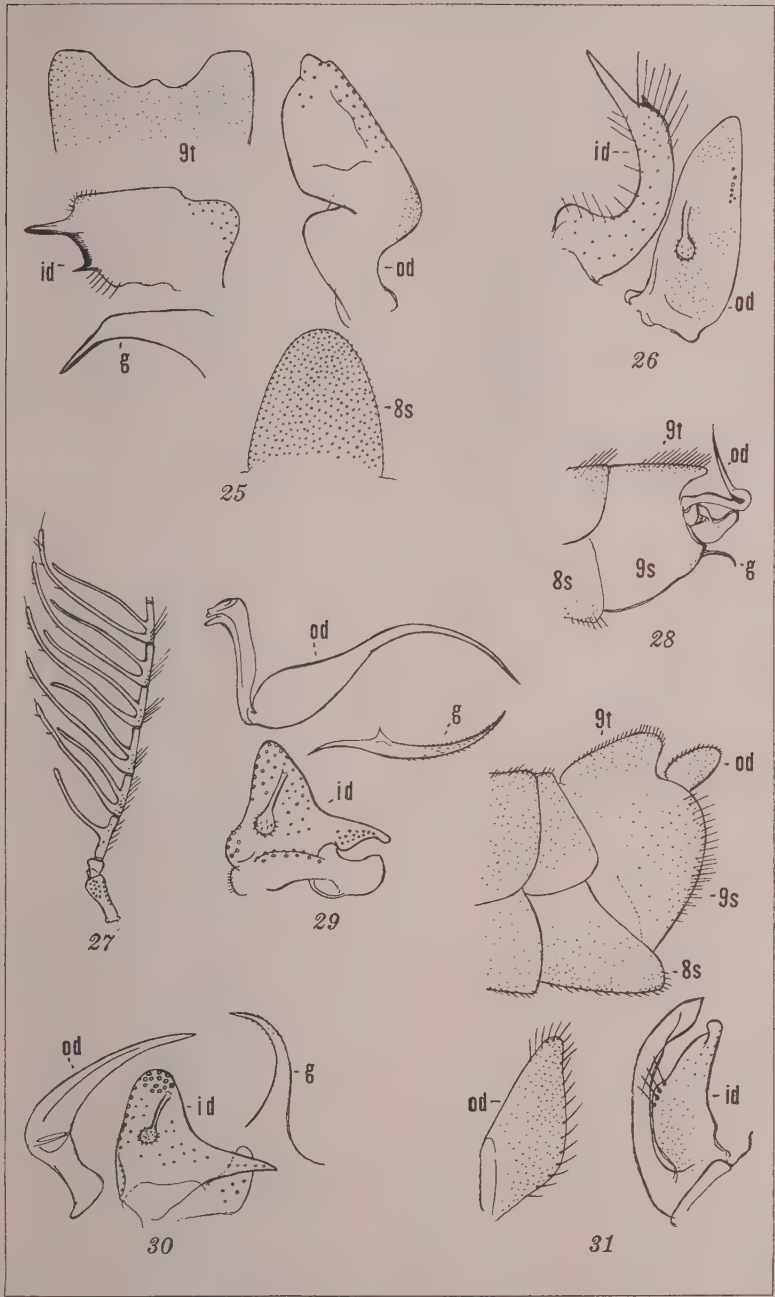


PLATE 2.

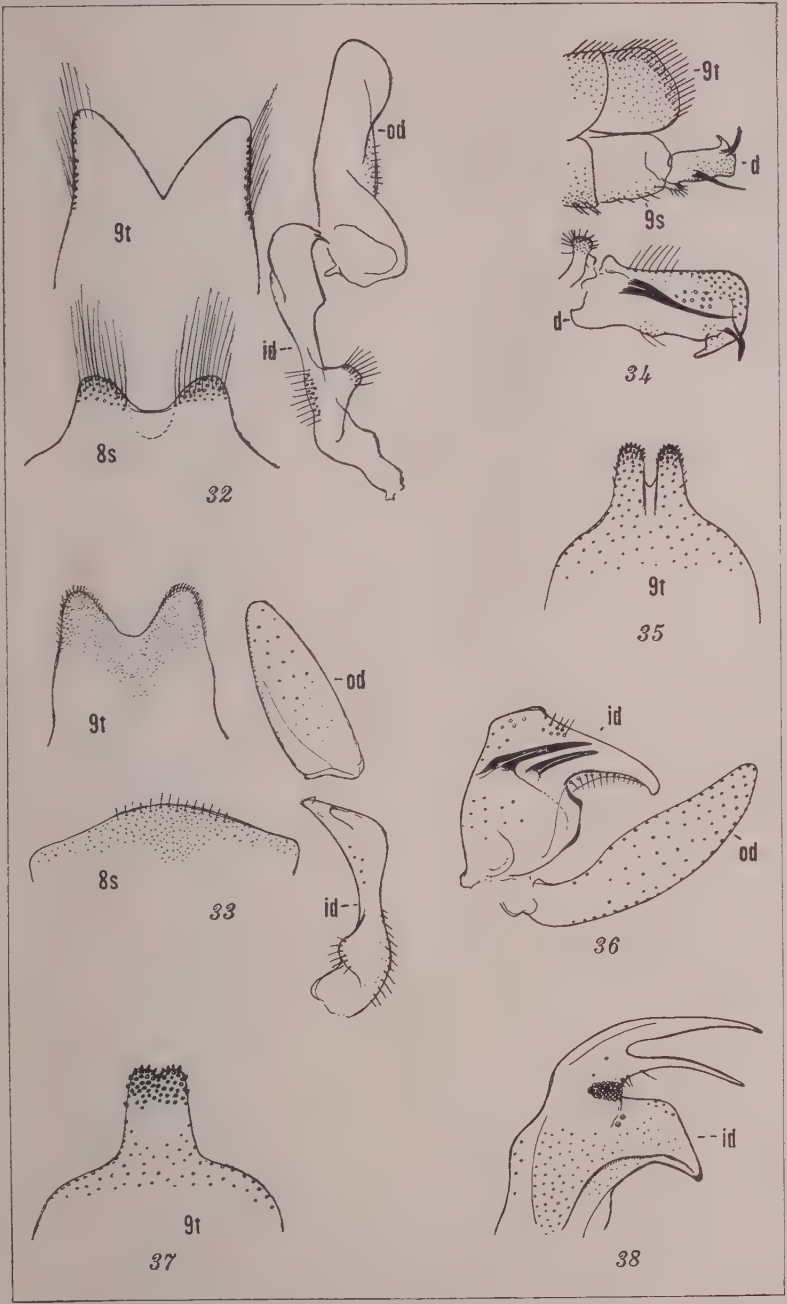


PLATE 3.

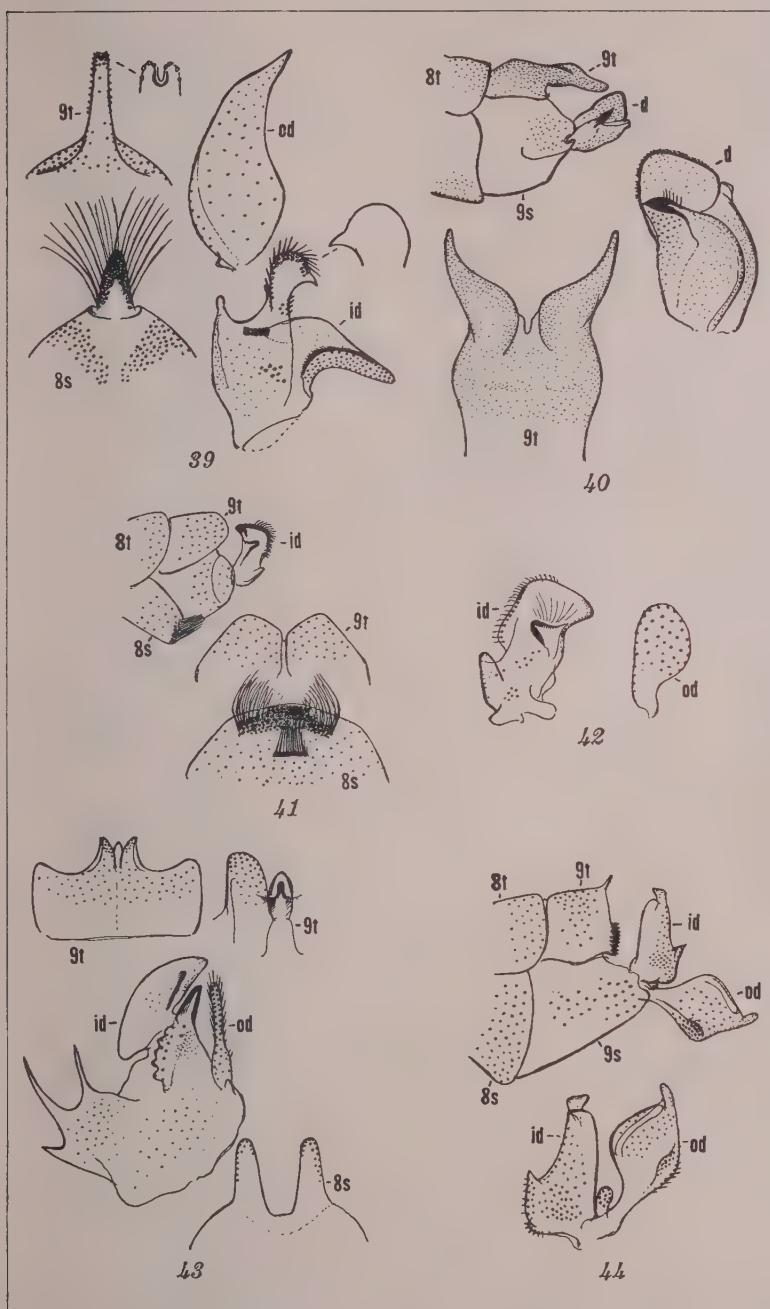


PLATE 4.

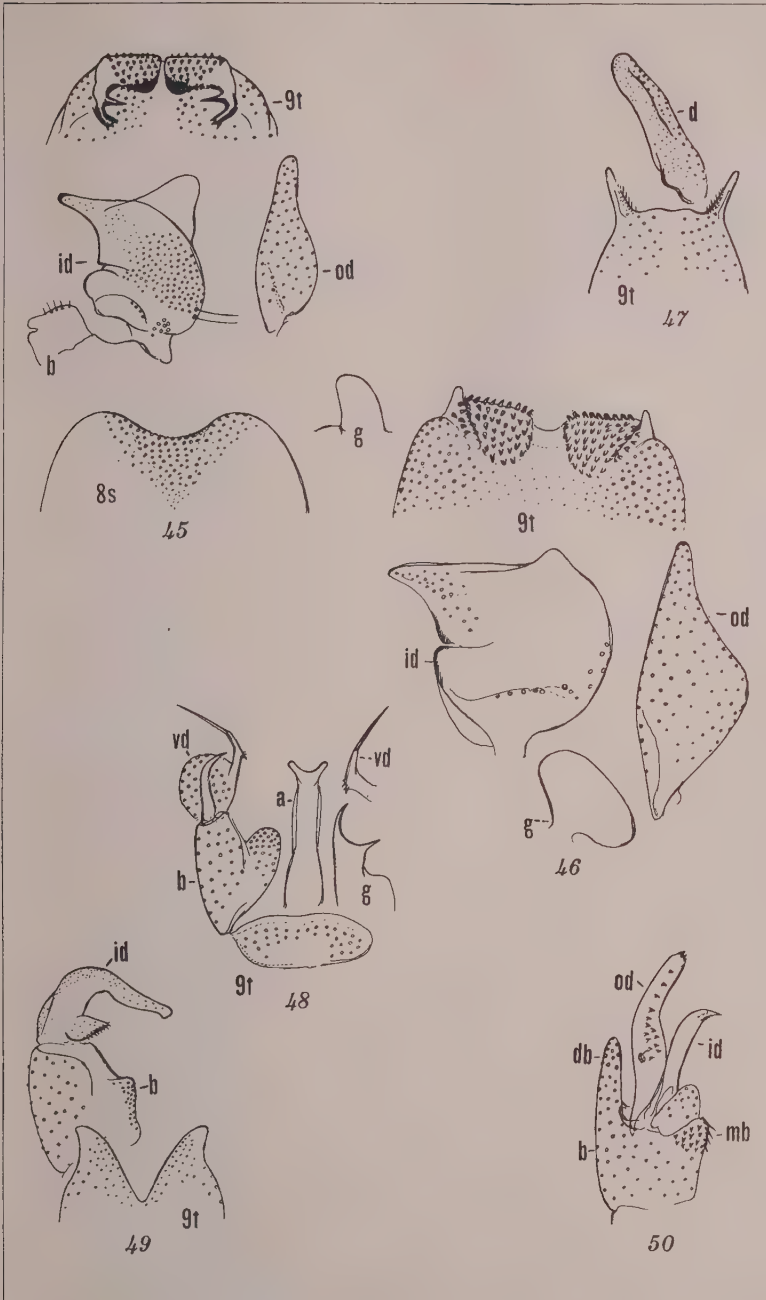


PLATE 5.

COLÉOPTÈRES MALACODERMES NOUVEAUX

Par M. Pic

APALOCHRUS CINCTOPLICATUS sp. nov.

Elongatus, postice latior, griseo pubescens et breve griseo hirsutus, paulo nitidus, nigrometallicus, capite thoraceque nigro-cyaneis, epistome albo, elytris viride-olivaceis, antennis nigris, ad basin testaceis. Capite parum breve, sparse punctato, antice biimpresso; oculis grandis, distantibus; antennis sat elongatis, parum gracilibus, undecim articulatis, articulo 2° minutissimo, fere indistincto, 3° ad 6° diverse et parum elongatis, 7° ad 10° longioribus; thorace subarcuato, antice et postice transverse impresso, minute pro parte sat dense punctato; elytris thorace latioribus, elongatis, postice paulo dilatatis, apice attenuatis, cincto (apice excepto) plicatis, intus humeros paulo impressis, minute et densissime ruguloso punctatis; pedibus gracilibus, elongatis. Long. 4 mill.

JAVA: Preanger.

Ex DRESCHER, communiqué par Wittmer.

Peut se placer près de *A. depressicornis* Pic, s'en distingue par l'avant-corps moins robuste, les antennes plus courtes, les élytres plus longues, olivâtres, et densement ponctués.

POLEMIOSILIS BOETTCHERI sp. nov.

Elongatus, nitidus, testaceus, antennis nigris, articulis duobus primis testaceo notatis et tribus ultimis flavis. Capite lato, thorace latiore, oculis nigris, valde prominulis; antennis elongatis, articulis 3° et sequentibus elongatis, diverse et mediocre latis, apice externe plus minusve prolongatis aut angulatis, ultimis gracilibus; thorace parum breve, lateraliter antemedium paulo latiore, postice fere recto, angulis posticis fere rectis, antice medio subarcuato, postice supra impresso; elytris thorace paulo latioribus, sat elongatis, parallelis, pro majore parte dense ruguloso—punctatis; pedibus elongatis, unguibus simplicibus. Long. 6 mill.

LEYTE, Santa Cruz.

Ex BOETTCHER, in coll. Pic et Wittmer.

Voisin de *P. proximus* Pic, s'en distingue, à première vue, par les pattes entièrement testacées avec les tarses un peu rembrunis.

POLEMIOSILIS LATIORITHORAX sp. nov.

Parum elongatus, subparallelus, nitidus, niger, femoribus ad basin, capite thoraceque rufis, scutello elytrisque testaceis. Capite cum oculos, his prominulis, nigris, thorace non latiore; antennis sat latis et depressis; thorace breve et lato, lateraliter medio paulo dilatato, antice subarcuato, angulis posticis paulo prominulis, supra medio sulcato; elytris thorace paulo latioribus, parum elongatis, dense granuloso—punctatis; pedibus gracilibus, unguibus simplicibus. Long. 8 mill.

Philippines, Surigao Province (coll. Pic).

Voisin de *P. forticornis* Pic, en diffère à première vue par le thorax plus large et de structure différente.

TUNA FISHING IN SOUTHERN MINDANAO

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*Of the Division of Fisheries
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NINE PLATES AND TWO TEXT FIGURES

Eight different species and varieties of Thunnidæ occur in large schools in the waters of southern Mindanao. The most abundant species is the striped tuna or skipjack, *Katsuwonus pelamis* (Linnæus). Next in abundance is the yellowfin tuna, *Neothunnus macropterus* (Schlegel). The bonitos, *Euthynnus yaito* (Kishinouye), *Auxis thazard* (Lacépède), *Parathunnus sibi* (Schlegel), *Neothunnus itosibi* Jordan and Evermann, and an undetermined species of *Thunnus* are also encountered in these waters. An unidentified species of yellowfin tuna, locally known as *panit*, is likewise found in certain waters of southern Mindanao. Of the above-named species *Neothunnus macropterus*, *Neothunnus itosibi*, *Katsuwonus pelamis*, and *Parathunnus sibi* are most desirable for canning purposes. The other four species and varieties are not canned because of undesirable dark flesh, overabundance of blood, and inadequate fat content.

Elagatis bipinnulatus (Quoy and Gaimard), the skin of which is used in the local preparation of artificial bait, is occasionally taken with the catch of tuna in Mindanao.

FISHING BOATS

The Sea Foods Corporation has four tuna fishing boats, namely "Sea Foods I," "Sea Foods II," "Sea Foods III," and "Sea Foods IV." The first two boats have the same shape and tonnage, each having a gross tonnage of 40.57 and a net tonnage of 27.59. The hull is 20.87 meters long, 4.30 meters wide, and 2.30 meters deep, and equipped with a 2-cycle, semidiesel, heavy oil engine of 100 H. P., 300 R. P. M. The hull and the engine of each cost approximately 10,000 pesos.¹ "Sea Foods III" and "Sea Foods IV" are also of the same shape and cost, each having a gross tonnage of 23.99 and a net tonnage of 16.63. The hull is 17.99 meters long, 3.59 meters wide, and 1.63 meters deep, and propelled by a similar engine of less power.

¹ One peso equals 50 cents United States currency.

The style and form of the four fishing boats are identical. They are flush deck vessels with low free-board aft, with the engine located amidship. There is a large clear afterdeck which is used as fishermen's quarters and for minor work, such as preparing the hooks with artificial bait, making hook base, line, and similar tasks. A trunk cabin for the captain is located slightly forward of and over the engine room, with a glassed-in shelter from which the boat is navigated.

Beneath the bridge, forward of and below the main deck, are the fishholds and bait wells. There are four of the former and three of the latter in the larger boats. The four fishholds are usually filled with blocks of ice, and the bait wells are left empty until the boat is near the live-bait station. When the boat is approaching the live-bait station, the eight large wooden plugs or stoppers which cover the connecting holes of the bait well with the sea water are removed to permit sea water to fill the bait well. Each of these three bait wells is about $2.5 \times 2.5 \times 2.5$ meters. The hatch coaming is about 1 meter square. After use, the wooden plugs are put in place and the sea water is pumped out. The bait well is then used as fishhold for preserving fish with cracked ice during the homeward trip.

The main deck is usually sheltered by a canvas awning which is either removed or folded during fishing operation. At the center of this deck, near the bow, is the foremast, with rigging used as a ladder in lighting the head lamp and as a lookout. On the lower part of the boat is the engine room. Besides the three bait wells there are two smaller bait tanks, one at the fore end and another at the aft end of the deck. Both are not permanently fixed and can be moved from place to place. They are used only during actual fishing. A rubber hose connected with the water pipe supplies them with sea water when necessary. From these bait tanks the live bait is scooped for chumming. Each tank has a capacity of 1 cubic meter. Along the sides of the boat are wooden platforms, one of which is used for fishing and the other for carrying fuel and the like. A portion of this platform is cut at the region of the detachable door of the deck to allow a space through which the live bait is transferred from the net or iron tanks into the bait wells.

Below the fishermen's quarters, at both aft and fore ends, are store rooms for supplies and miscellaneous paraphernalia. In the smaller fishing boats only two of the three bait wells are

utilized for live bait, the other serving as an icehold which is also used as a fishhold. There are six small fishholds in these boats, but not all are used. The two fishholds located forward are used as fresh water storage, the two middle holds as storage for fuel and other supplies, and the two holds at the stern for ice and fish.

FISHERMEN

The fishermen of the Sea Foods fishing boats are Japanese who are either experienced fishermen or graduates or former students of different schools of fishery in Japan. The Filipino fishermen selected by the Sea Foods Corporation to undergo training under these Japanese fishermen are laymen, some of them practically without any academic attainment. From among the Japanese fishermen is usually selected a master fisherman who, at the same time, acts as the captain of the boat. A Japanese also licensed as a fisherman performs the work of the machinist. The Filipino fishermen serve as members of the crew.

FISHING PARAPHERNALIA

The most important fishing implement used in the fishing boats of the Sea Foods Corporation is the pole and line with different types and sizes of hooks. The fish pole is made of Japanese bamboo. It is 4 meters long and has a diameter of 4 centimeters at the base and 1.5 centimeters at the end. It is strong, pliable, and light. The basal portion of about 70 centimeters is provided with a few coils of twine to roughen the surface for better grip. At the distal tip are attached two strong, short cords for the attachment of the two lines, one for the artificial bait line and the other for the live-bait line. These cords are firmly attached to the pole by coils of strong abaca twine. To each of these short cords, a line of about 261 centimeters is connected. At the end of this line is a fine, strong steel wire about 30 centimeters long which may be single or double and twisted to hold the hook. One hook is provided with artificial bait made of white feathers partly wrapped by a piece of pink cloth and dried fish skin. The imported prepared skin is that of the puffer fish. The local substitute is dried skin of *Elagatis bipinnulatus*. The other hook is bare and is used with live bait. The line described above is the ordinary long fish line which is only slightly shorter than the pole itself. The other line is about half or less than half the length of the

pole and usually single. It is provided with the hook with artificial bait. This short fishing line is seldom used.

The fisherman's apparel is usually a thick brownish gown or dark-colored pajama. This gown protects the fishermen from the splashing of blood escaping from the gills of the fish as these wriggle on the deck soon after being landed. Some fishermen use aprons. A rubber or canvas padding about 6 inches square is tied with a strap of canvas or with a small rope and hung over the shoulder, the pads resting over the hip to support the base of the fishing pole during angling.

Small dip nets are used to scoop the live bait from the bait wells of the fishing boat into galvanized-iron or wooden pails which are taken to the two small bait tanks at both ends of the boat. Each of these bait tanks is under the care of one fisherman who, with a small dip net, scoops the live bait to be chummed into the sea to attract the tuna fishes from time to time.

The fish line is made of ramie fibers. The fibers are twisted a little and coiled loosely around two poles or posts on the deck. A spool of fine twisted twine or coarse thread made of the same material is inserted into a wooden coiler (text fig. 1). This coiler when rotated at high speed causes the twine or thread to be finely coiled around the loosely stretched fibrous ramie material and produces a very strong fish line. The mechanism and the operation are very simple (Plate 4, figs. 1 and 2).

There are two general types of hooks used. In one type the hook is firmly fixed to a brass or lead handle (Plate 2). The hook with a brass handle is imported from Japan, while the hook with lead is made in the boat. The size of the handle varies with the size of the hook mounted on it. The largest hook measures 2.5 cm in length and 1 cm in diameter at its base. The greatest width of the largest hook is 2.5 cm. The smallest hook is 1.5 cm long, 0.7 cm in diameter at the base, and 1.7 cm wide. The mounted limb of the hook is wrapped with a piece of the transparent skin of the puffer fish and tied or sewed together with a few white feathers. The artificial bait made in the boat consists of native birds' feathers of different colors, with a small piece of pink satin cloth around the base and wrapped with a small piece of dried skin of *Elagatis bipinnulatus*. A white bird feather is considered best.

The other type of hook has a base in the shape of a bullet to which it is not firmly fixed. The base is made of lead and brass with eyelets of mother-of-pearl shell on both sides and a small

bore along its entire length for the passage of a wire to hold the hook. The artificial bait used is of the same material used in the other type and is attached to the neck of the bullet-shaped

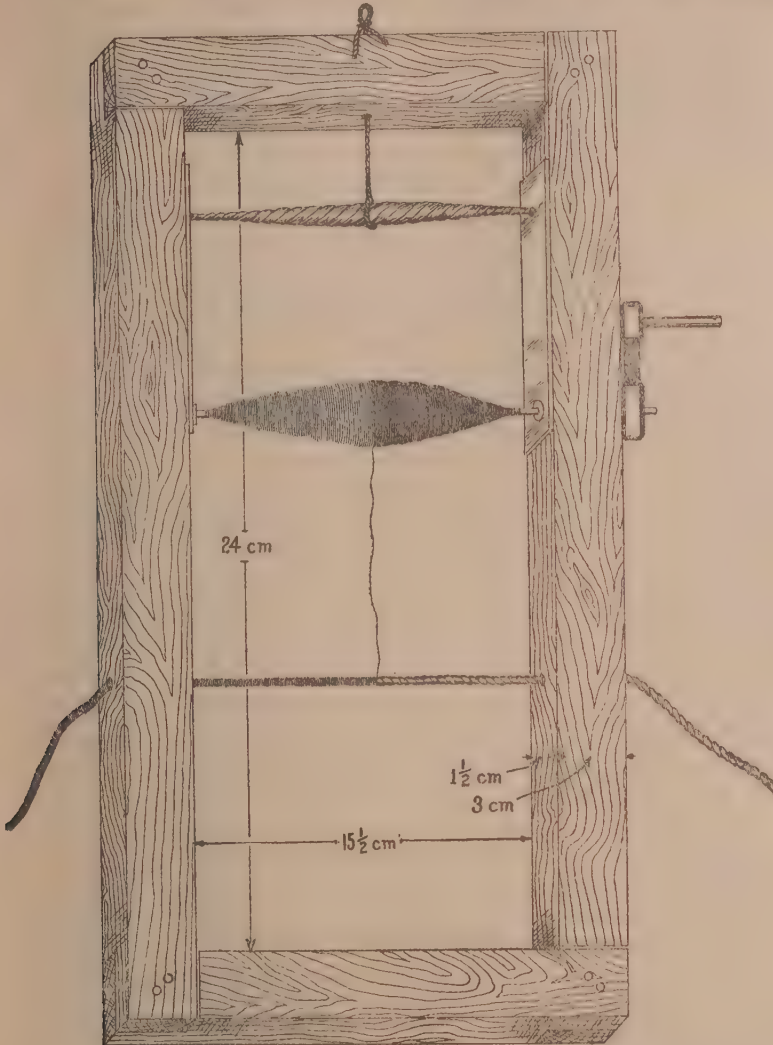


FIG. 1. A wooden twine collar used by the Sea Foods fishing boats in making fishing lines.

base. The hook is tied to a fine steel wire which is inserted through the eye of the base, making the hook movable. The limbs of the largest hook are 5.5 cm and 3 cm long and 3 cm wide. The limbs of the smallest hook are 3 cm and 1.8 cm long

and 1.7 cm wide. The large hook with artificial bait is usually used in connection with trolling to catch the larger fishes. The smaller hook is used with the long-line fish pole, at the rear end of the fishing boat only. The smallest hook is usually used for live bait together with the long fish line.

Other types of hooks for trolling purposes are also found in the boat but are seldom used. They may be used only to catch large yellowfin tuna or other large game fishes.

LIVE BAIT

The live bait used consists of several species of *Sardinella* found around Zamboanga and Davao provinces. The most common are *Sardinella melanura*, *Sardinella perforata*, *Sardinella fimbriata*, *Sardinella leiogaster*, and another species of *Sardinella* with large eyes and a yellow spot near the operculum. The last two species are considered the best because they remain alive long in captivity. In the absence of sardines, other fishes, such as large-sized anchovies and silversides (*Stolephorus indicus*, *Atherina duodecimalis*, and other species of the same genus), *Sphyræna obtusata*, *Dussumieria hasseltii*, small or young *Rastrelliger chrysozonus*, *Scomberoides tolo*, *Megalaspis cordyla*, and others may be used.

Live bait is caught at live-bait stations by means of a net locally known as *sangab*, a modified *lawag* net. This net is placed against the current with the aid of two dugouts, or *sapiaoan*, while several dugouts with lights attract the fishes during dark nights. The live bait caught is transferred into the net tanks also with the aid of light. The net tanks are 6 fathoms in diameter and 2 fathoms deep; they are kept floating with the aid of six wooden rims in the form of a hexagon.

The live bait is later transferred to the live-bait wells of the fishing boats by means of a small seine called *signin* (Plate 5, fig. 2). In this transfer some twelve men are needed. Four or five men board a small dugout and take charge of the net or iron tank together with the *signin*. A similar or greater number of men in the fishing boat haul the live fishes from the net tank or iron tank. A number of men are also needed to transfer the fish from the *signin*, with the use of wooden buckets or pails which are handed from one person to another to be taken to the bait wells of the boat (Plate 6, figs. 1 and 2). The transfer is done quickly, while at the same time the spilling of fish is avoided. One man is detailed to each of the three bait wells to look for weak fishes which are scooped up with the

small dip net and thrown away. One live-bait well may accommodate as many as 4,000 to 5,000 sardines. When enough live bait is in the bait wells, the engine is started and the boat is kept slowly moving to aerate the live fishes. This is done continuously, even when the boat has already reached the fishing ground at night. Only during rough sea the boat stops, as during this time water coming from large waves gains access to the bait well through screened holes and serves the purpose of aëration. At night the bait wells are lighted to enable the night guard to see and remove dead fishes.

TUNA FISHING GROUNDS

The tuna fishing grounds for Zamboanga boats are Sibuguey Bay around Olutanga Island and the neighborhood of Angosto Shoal; the whole Moro Gulf around the neighborhood of Basilan Island, Illana Bay; Celebes Sea along the Sulu Archipelago; the neighborhood of Cotabato up to Sarangani Bay; the entire Sulu Sea from the western side of the Zamboanga Peninsula opposite Port Santa Maria, Sibuco Bay particularly in the neighborhood of Sangboy Island, and toward Palawan along the Tubbataha Reefs, the Cagayan Islands; and the neighborhood of the Cagayan de Sulu.

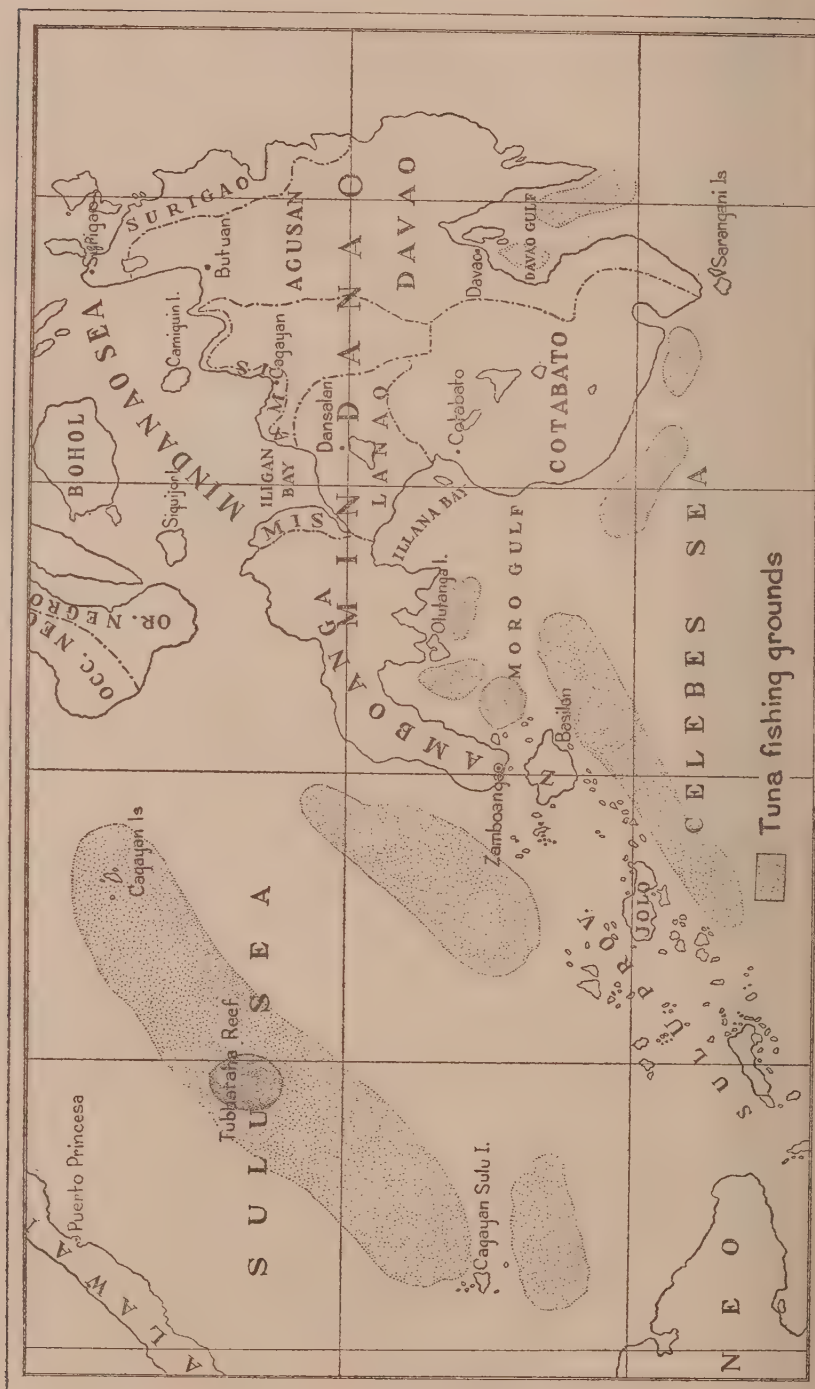
The western half of Davao Gulf, from south of Talicod and Samal Island to north of Malita, together with the eastern two-thirds of the entrance of the gulf from off Monserrat to within 20 miles south of Cape San Agustin, constitute the tuna fishing ground of Davao fishermen (text fig. 2).

Generally the period from April to June inclusive is the best tuna-fishing season. The peak of the fishing season is during May. The slack months are from July to November.

FISHING OPERATIONS

Expert fishermen can tell where a school of tuna fishes is located within a distance of 3 miles. One important guide used is the presence of sea gulls, which usually fly very close to the surface of the water in circles while feeding on small fishes, like the sardines, which are usually followed by schools of tuna. Dark vibrating portions of the sea in calm weather is another good indication of the presence of a school of sardines which are usually followed by tuna. The leaping and splashing of the tuna from the surface of the water visible at close range is of course a sure indication of the presence of a school of tuna.

Although the master fisherman, who posts himself at the wheel house, actually does the work of sighting for fishes,



other fishermen may help. Usually the bowsprit and the rigging of the foremast are used by the fishermen for scouting the school. When a school of tuna fish is sighted, the master fisherman signals the engineer to speed up while he steers to the location of the school. When the boat approaches the school, the master fisherman gives a signal to open the valve of the side tubes which throw a shower of water around. The two small live-bait tanks are supplied with fresh sea water from a pump. A few pails of live bait are transferred into them from the live-bait wells. The fisherman who stands over the edge of the bait tank starts scooping a few of the live sardines with a small dip net and throws them into the water as far as he can. This process, known as chumming, is continued before and during the actual fishing. All fishermen with their fishing tackle line up on the fishing platform along the sides of the boat. As soon as the school of tuna is seen near the boat, the fishermen start working with their tackles. Within a few minutes the deck of the boat is covered with tuna. When the early catch consists of an undesirable variety, the master fisherman stops the fishing operations and steers the boat to another place.

Most fishermen are skillful and quick in hooking tuna. Most of them use the long fish line, although a few may use the short line. The line with artificial bait is first used. When the tuna stop biting at this the line with live bait is used. When the fishes stop biting and begin to swim away from the boat the master fisherman gives a signal for the boat to proceed to another place. The unused live bait is returned to the bait wells.

When the fish is caught with the long line pole, the fisherman lifts up the pole steadily and draws the fish toward himself and holds it between his left arm and his left breast while the hook is removed by the right hand. In some cases the fish automatically releases itself from the hook before the fisherman takes hold of it. When the fish is large, the fisherman simply holds the line near the hook and jerks it to release the fish. When the short-line fish pole is used, the fisherman lifts the pole and raises the fish, and with a jerk or skillful manipulation of the pole, drops the fish down from the hook without touching it. An expert fisherman catches more fish with the short-line fish pole than with the long line.

The average duration of actual fishing in one encounter is about 10 minutes, although it depends largely upon the food available to tuna at the time. When the tuna are hungry, fishing in one encounter usually last longer. In case tuna will not

bite, due perhaps to abundance of food, actual fishing is not done. When numerous fishes are caught and plenty of blood escapes from their gills and drips into the sea, sharks are attracted and feed on the tuna fishes if one fishing operation lasts more than 10 minutes. There are instances when before a fish could be landed, it is either swallowed whole or cut off by a shark.

PRESERVATION OF THE CATCH

The fishing boats of the Sea Foods Corporation preserve their catch with crushed ice. Before leaving the cannery, the four ice- and fishholds in the larger fishing boats are fully loaded with ice. In the smaller boats one of the bait wells and two fishholds are usually filled with ice.

After a good catch one of the fishholds filled with ice is emptied. Some of the ice is transferred to other fishholds, while the rest is cracked. A layer of crushed ice is placed inside the emptied fishhold, followed by a layer or two of fish which are again covered with crushed ice. A separate floor is placed over the last layer of ice before the process is repeated. By this method the fishhold is completely filled up with fish. When all the fishholds are filled up with fish, bait wells may be emptied of live bait and converted into fishholds. There are times during the peak of the fishing season when the catch cannot be accommodated underdeck. Upon reaching the cannery, the fishes to be used immediately are not stored, but simply placed in large wooden tanks with layers of crushed ice above and below.

Formerly, when the Sea Foods cannery did not have a wharf, unloading of fish was tedious. The fishes were placed in baskets and were taken to the shore by small boats and carried to the cannery by the fishermen. With improved facilities the fishing boat just heaves to and unloads at the wharf. Usually 20 fish are placed in a basket. This is then weighed and recorded. The baskets are then taken into small rail cars and pushed to the cannery.

REMARKS

The method of tuna fishing in Southern Mindanao and Sulu is not conducive to depleting the tuna fishing grounds. Even if fishing is done continuously throughout the year, with only the present number of fishing boats engaged in tuna fishing there appears to be no danger of exhausting the supply, the

fishing ground being extensive and rich. Of the fishes encountered in one school, only a small portion, about 1 to 10 per cent, are caught. Young and small tuna fishes are left undisturbed, while extraordinarily large one that could not be caught by the single pole and line, are usually left unmolested.

TABLE 1.—*Tuna fishes caught by the Sea Foods fishing boats from August 1937 to July 1939.*

Month and year.	Yellowfin.			Striped tuna.		
	Number.	Total weight.	Average weight.	Number.	Total weight.	Average weight.
1937		<i>Kg.</i>	<i>Kg.</i>		<i>Kg.</i>	<i>Kg.</i>
August.....	3,144	10,109	3.22	10,118	33,179	3.28
September.....	6,544	20,264	3.25	19,673	52,979	2.69
October.....	5,118	18,329	3.58	15,258	52,393	3.43
November.....	1,744	3,939	2.26	7,147	26,209	3.67
December.....	1,988	6,391	3.21	14,559	47,070	3.23
1938						
January.....	1,976	8,244	4.17	15,290	52,732	3.45
February.....	2,501	10,057	4.02	22,842	75,870	3.32
March.....	3,366	14,667	4.03	12,758	45,224	3.54
April.....	2,937	14,680	4.98	50,608	165,069	3.26
May.....	9,250	34,392	3.71	62,715	179,348	2.85
June.....	4,930	18,011	3.75	45,747	122,661	2.68
July.....	5,367	19,252	3.58	23,640	62,576	2.64
August.....	5,037	23,654	4.69	22,976	68,957	3.87
September.....	6,478	23,961	3.69	16,337	52,521	3.21
October.....	6,350	20,828	3.27	21,957	66,045	3.01
November.....	9,493	33,284	4.03	19,990	68,651	3.43
December.....	7,326	26,443	3.62	26,338	96,861	3.29
1939						
January.....	3,497	12,004	3.43	43,961	156,547	3.56
February.....	2,562	10,664	3.05	45,544	160,538	3.52
March.....	4,702	16,728	3.55	39,539	132,052	3.34
April.....	8,344	29,760	3.57	74,791	235,088	3.14
May.....	7,388	30,133	4.08	75,903	224,463	2.92
June.....	6,586	22,866	3.47	43,972	131,787	2.99
July.....	6,247	19,511	3.12	23,638	69,835	2.95

As a precaution against possible depletion, it may, however, be advisable to establish a close season after the exact spawning season is determined. Samples of gonads of representative specimens should be collected every month and studied macro- and microscopically. The main object should be to correlate the size of the fish with the mature gonads to find out the parts of the year when the reproductive cells reach maturity.

Reports from abroad tend to show that purse-seine boats work hard on the tuna fishing grounds. The use of the purse seine should be discouraged as much as possible in Philippine tuna grounds. If its use cannot be prohibited entirely its operation

should be allowed only during those parts of the year when live bait is not readily available.

Table 1 shows that small as well as extraordinary large fishes are not usually caught, although at times some large fishes may be included. In the same table are shown the average weight of the yellowfin and the skipjack (striped tuna). While the latter does not exceed 5 kilograms, the former may attain a weight of around 30 kilograms. Skipjacks caught from October to April are usually large and weigh no less than 3 kilograms.

ILLUSTRATIONS

PLATE 1

- FIG. 1. Yellowfin tuna, *Neothunnus macropterus*; average weight, 4 to 5 kilograms.
2. Yellowfin tuna, *Neothunnus macropterus*; around 30 kilograms.
 3. Yellowfin tuna, *Neothunnus itoshibi*; around 70 kilograms.
 4. Striped tuna or skipjack, *Katsuwonus pelamis*; average weight, 3 kilograms. Most abundant species.
 5. Bonito, *Euthynnus yaito*; average weight, 3 kilograms. An undesirable species for canning.
 6. A species of *Thunnus*, still undetermined, average weight, 3 kilograms. An undesirable species for canning. No yellow color.

PLATE 2

- FIG. 1. Hooks used in connection with pole and line. First row: two sizes of hooks used with artificial bait; second row: first hook, used without artificial bait, and the last two, used with live bait.

PLATE 3

- FIG. 1. Another variety of yellowfin, still undetermined; average weight, 3.5 kilograms. An undesirable species for canning.
2. Two species or varieties of yellowfin tuna; left, *Parathunnus sibi*, and right, undetermined variety in fig. 1.
 3. The Sea Foods fishing boats at the landing place.

PLATE 4

- FIG. 1. A fisherman making a fishing line with the aid of the small wooden twine coiler illustrated in text fig. 1.
2. Same as in fig. 1, showing the revolution of the wooden twine coiler in actual operation.
 3. Loading blocks of ice on the Sea Foods fishing boat.

PLATE 5

- FIG. 1. Preparatory to putting live bait into the bait wells of the fishing boat.
2. Hauling of live bait from the iron tank to be placed in the bait wells of the fishing boat.
 3. One of the smaller fishing boats, "Sea Foods No. IV," in dry dock.

PLATE 6

- FIG. 1. Transferring the live bait from the small seine (siguin) into the bait wells of the fishing boat.
2. Placing the live bait into the bait wells of the fishing boat.
 3. Fisherman in actual fishing operation with pole and line.

PLATE 7

- FIG. 1. A fisherman chumming a school of tuna with live sardines from the small bait tank with a small dip net.
2. Another fisherman chumming.

PLATE 8

- FIGS. 1 and 2. Fishermen in fishing operation with pole and line.
FIG. 3. A view during fishing operation, showing a portion of the catch on deck.

PLATE 9

- FIG. 1. Fishermen with poles and lines, after fishing operation.
2. Unloading tuna from the fishing boat to the wharf.
3. Carrying the tuna in baskets on rails from the landing to the cannery, after unloading from the fishing boat.

TEXT FIGURES

[Drawings prepared by Pio C. Medel.]

- FIG. 1. A wooden twine coiler used by the Sea Foods fishing boats in making fishing lines.
2. Map of tuna fishing grounds in southern Mindanao.



PLATE 1.



PLATE 2.



1



2



3

PLATE 3.



1



2



3



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3



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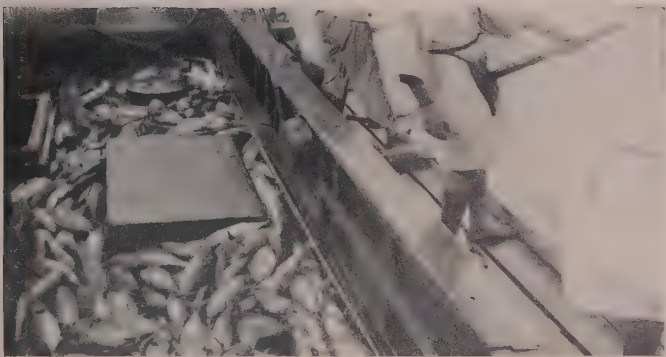
PLATE 7.



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PLATE 8.



1



2



3

A PRELIMINARY STUDY OF THE LIFE HISTORY OF *SCYLLA SERRATA* (FORSKÅL)¹

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THREE PLATES AND ONE TEXT FIGURE

Scylla serrata (Forskål), commonly known as *alimaño* in the vernacular, belongs to the Family Portunidæ, which includes all swimming crabs having the last pair of ambulatory legs natatorial and the terminal joint oval, compressed, greatly broadened, and paddlelike. This species is considered a table delicacy in the Philippines, where it forms the basis of an extensive crab fishing industry. It is generally caught in commercial quantities by means of a trap (*bintol*), a hook (*panukot*) (text fig. 1), and in scissor (*sakag*) and gill (*pante*) nets. Because of the ease with which the newly hatched *alimaño* is



FIG. 1. The hook (*panukot*) employed to catch *alimaño*.

caught, it is now extensively cultivated in fishponds together with the milkfish (Tagalog: *bangos*), *Chanos chanos* Forskål, of the Family Chanidæ. Ranking next to the *alimaño* in commercial importance is the *alimasag*, *Neptunus pelagicus* Linnæus, which also belongs to the Family Portunidæ. Both species have the same habitat and are caught with the same types of gear.

Although the *alimaño* occurs in most marine regions of the Philippines, it is especially abundant in swampy places and rivers reached by tidal waters. The sponge-bearing crabs tend to remain in the sea, but the young come inshore or into rivers adjoining Manila Bay for food and shelter. This phenomenon is evident during the spawning season; that is, from the last

¹ Work done at Dagatdagatan, Fishery Experimental Station.

week of May to the third week of September. The migration of the young crabs to brackish waters takes place about a month after the start of spawning activity.

There has been a rapid increase in the number of traps and nets employed to catch both young and mature alimaño, and their use, if not lawfully restricted, may lead in the long run to the depletion of the crab fishery. A study, therefore, of the life history of the alimaño and its cultivation in captivity, is timely and important, if an attempt is to be undertaken at all to formulate regulatory measures for the protection of the crab resources of the Philippines.

GENERAL HABITS

Progression of the alimaño through the water is effected by means of the sculling movements of the last pair of ambulatory legs. If the alimaño becomes alarmed, it moves away very rapidly by a combined movement of the walking and natatorial legs. When on the bottom and undisturbed, the crab may be seen to walk slowly about on the tips of the second, third, and fourth pairs of walking legs. The large pincers are folded close to the anterior lateral borders, and the ambulatory legs are either raised posterolaterally or assisting the movements by slow, sculling strokes. In shallow ponds or in streams which become dry at low tide, the crab digs into the mud, apparently to rest or to avoid excessive exposure to heat. There it waits for the rising tide to give it an opportunity to move about again.

When angered, the alimaño raises its claws and with the pincers wide open, is ready to attack its adversaries. When intruded upon, it takes the intruding object in a firm hold. If a little force is applied against the tight grasp of the crab, the animal sacrifices one and sometimes both pincers for its safe escape.

PHYSICAL CHARACTERS

The color of the alimaño resembles that of the surroundings. Except for the proximal ends of the pincers, which are orange-red, the color of the dorsal surface of the carapace and appendages is like that of baños fish-pond mud. The young or newly hatched alimaño can be easily distinguished from the young alimasag by the delicately tinted, dark streaks on their carapace and legs. The proximal ends of their pincers are reddish, while in the alimasag these portions are ivory-white.

FEEDING HABITS

The alimaño is both a scavenger and a cannibal. In their natural habitat the larger crabs often attack the smaller and weaker ones by first pulling off the appendages and then breaking the carapace into pieces to excavate the softer parts of the body. In glass aquaria the crabs feed on small fishes and shrimps given them as food twice a week. The small live fishes and shrimps are seized by the quick movements of the pincers. The food is pushed back to the mouth with the aid of the second pair of legs. It is thoroughly masticated by the hard jaws and the complicated set of teeth in the stomach. The crabs, either in captivity or in their natural habitat, may be seen feeding on algæ and decaying pieces of wood and bamboo sticks.

ECDYSIS

The crabs grow when they molt. Churchill,⁽¹⁾ in his study on the life history of the blue crab, *Callinectes sapidus*, states that the crabs molt because they have grown, and the shell, not being elastic, is too small and is thrown off. There is an abrupt increase in size due to the expansion of the body, which has previously been crowded and wrinkled up within the old hard shell. The molting process of the alimaño was observed in captivity. A female crab measuring 9 by 12 millimeters was confined in an aquarium September 8, 1938. On the second day this crab molted. The size of the empty shell and the soft, wrinkled meat were 9 by 12 and 14 by 17 millimeters, respectively, showing an increase of 5 by 5 millimeters. Table 3 shows that the average increase in the size of crab A for eleven successive molts is 4.9 by 8.5 millimeters.

Preparatory to molting, the crabs abandon their hideouts or conical holes to shed their shells. In fact, empty shells are frequently found about the mouths of mud holes. After throwing off the hard shells the crabs move away as far as possible to avoid their enemies, especially their own kind, which may prey upon their soft unprotected flesh upon entering the hole. The soft crabs bury in the mud deep enough to conceal themselves until the shells attain a state of complete hardness.

AUTOTOMY

Closely related to ecdysis is the automatic throwing off of the appendages, known as autotomy. The pincers, especially,

are sacrificed by the crab for its safe escape. The clipping off often occurs along the suture which separates the coxa, the basal segment of the legs, and the basis. At this end a new appendage is regenerated. At first a very small transparent papilla protrudes at the proximal end of the cut portion. The papilla enlarges until a white translucent sac is formed with the tiny appendage enclosed in it. After four successive molts this appendage assumes its normal form and shape. Churchill states that if an appendage is lost shortly after a molting, the regeneration will be made at the next molting. The same author further states that if the throwing off of the appendage occurs a few days before a molting, the renewal takes place at the second subsequent molting.

BREEDING

Mating is necessary to fertilize the eggs of a female alimaño. The actual copulation has never been closely observed, although instances have been noted when the male held the female. The female is carried about by the male which clasps her tightly, back uppermost against the dorsoposterolateral region of the body by means of the three pairs of walking legs. The hold is so firm that both individuals are easily caught. This pair of mating crabs are called doublers, locally known in Tagalog as *kalong*. The female usually held by the male is either one that has just molted to sexual maturity or a virgin known in Tagalog as *bayugin*. Churchill states that if the female blue crab in the peeler state is left with the male, copulation ensues as soon as she has molted and while yet soft. The same author further reports that copulation in the blue crab takes place during the last molting, when the triangular-shaped abdomen changes to a broad, rounded form.

In the present experiment, each time a virgin crab molted in captivity, a male was immediately placed in her cage. The male upon encountering the helpless female, instantly grasped her by means of his three pairs of walking legs. Five days later the male released the female. The same pair, when not separated at once, attempted to kill one another.

A mated and an unmated female crab were confined separately in float cages in the river. Both of these crabs developed eggs which were laid normally. To the naked eye the sponges carried by both crabs were similar. Microscopically the difference was that the eggs of the mated crab were fertilized.

Fertilized eggs on being laid have already developed to the blastula stage. (Plate 3, fig. 1). It is safe to conclude, therefore, that eggs develop normally in the ovaries of the alimaño even without the intervention of the males. Churchill states that the enlarging of the ovaries of the blue crab is not dependent upon copulation, and that the eggs likewise increase in size even if mating has not occurred.

Copulation takes place immediately after the abdomen of a female alimaño has changed from its triangular shape into a broad, rounded form. At this stage, the alimaño has not developed eggs in the ovaries. Since copulation occurs before oögenesis, it is assumed that the spermatozoa are implanted in the body of the female and that fertilization takes place internally. Churchill reports that the eggs of the blue crab are in all probability fertilized as they pass through the sperm sacs of the female.

SPAWNING CHARACTERISTICS

Crabs spawn throughout the year, but the peak of this activity is from the last week of May to the third week of September, a period covering approximately four months. From April to May mature female crabs begin to develop eggs in their ovaries. These eggs are of two classes; namely, and immature and an intermediate age group of eggs, known in Tagalog as *aligui*. The *aligui* is orange-red, and can easily be detected by examining the protogastric and branchial regions of the carapace. The immature age group of eggs are milk-white, and are not visible externally. These eggs are very irregular in shape. Table 1 shows the percentages of non-sponge-bearing and sponge-bearing alimaño in catches of bintols and fish corrals, and Table 2 shows monthly averages of sponge-bearing alimaño.

When the alimaño are about to spawn they are fat and generally sluggish. They are less aggressive even in securing food. The abdomen is swollen and vascular. April 5, 1938, three female crabs were confined separately in float cages for observation. Twenty-two days later the appearance of the *aligui* became highly discernible through the protogastric and branchial regions of the carapace. Two days later the crabs began to spawn. It took about seven days to expel the *aligui* from the ovaries. Microscopic examination of the ovaries of spent females showed the remains of a few of the immature age

TABLE 1.—Percentage of non-sponge-bearing over sponge-bearing *alimany* taken from the catches of bintols and fish corrals.

Date.	Male.		Female.					Total.
	Num-ber.	Per cent.	Num-ber ex-amined.	Non-sponge-bearing.	Per cent.	Sponge-bearing.	Per cent.	
1938								
February 1.....	54	38.57	86	86	61.43	0	0	140
February 7.....	42	30.44	94	93	67.39	1	2.17	136
February 15.....	49	32.02	104	104	67.98	0	0	153
February 22.....	64	38.79	101	98	53.33	3	7.88	165
February 28.....	57	35.63	103	102	63.75	1	0.60	160
March 1.....	49	41.08	68	67	57.26	1	1.71	117
March 10.....	36	42.86	48	48	57.14	0	0	84
March 19.....	39	41.94	54	51	54.84	3	3.22	93
March 27.....	33	31.13	73	71	66.98	2	1.89	106
April 4.....	77	43.30	93	93	54.70	0	0	170
April 15.....	53	37.06	90	89	62.24	1	0.70	143
April 23.....	29	26.85	79	77	71.29	2	1.86	108
April 30.....	44	34.65	83	88	65.35	0	0	127
May 7.....	92	42.65	125	124	57.40	1	0.01	217
May 14.....	51	46.06	62	58	53.21	4	0.73	113
May 21.....	43	35.83	77	72	60.00	5	4.17	120
May 28.....	27	31.76	58	49	57.65	9	10.59	85
June 7.....	86	28.57	90	73	58.19	17	13.24	126
June 12.....	55	30.05	128	97	53.01	31	16.94	183
June 19.....	30	22.41	107	69	50.36	38	27.73	137
June 26.....	70	28.57	175	112	45.72	63	25.71	245
July 3.....	59	32.96	120	92	51.39	28	15.65	179
July 12.....	71	37.49	141	89	41.98	52	24.53	212
July 19.....	73	31.06	162	110	46.81	52	22.13	235
July 26.....	108	28.88	266	189	50.53	77	20.59	374
August 3.....	32	16.58	160	86	44.88	74	38.54	192
August 13.....	23	24.93	68	30	32.87	38	42.20	91
August 21.....	76	44.19	96	27	15.69	69	39.82	172
August 29.....	18	13.29	110	77	60.93	33	25.78	128
September 3.....	27	18.88	116	84	58.74	32	22.38	143
September 13.....	77	25.08	230	189	61.58	41	13.36	307
September 19.....	42	21.87	150	131	68.23	19	15.90	192
September 26.....	56	41.47	79	71	52.59	8	5.94	135
October 3.....	61	42.20	27	22	52.17	5	3.63	133
October 10.....	40	36.70	67	62	56.88	7	6.42	109
October 17.....	38	42.20	53	51	56.04	2	1.76	91
October 25.....	17	36.17	30	29	61.70	1	2.13	47
November 1.....	72	47.06	81	81	52.94	0	0	153
November 8.....	80	29.41	72	70	68.63	2	1.96	102
November 15.....	59	38.56	94	93	60.78	1	0.56	153
November 22.....	35	37.50	45	45	62.50	0	0	80
November 29.....	31	32.63	64	64	67.36	0	0	95
December 5.....	88	34.64	166	162	63.78	4	1.85	254
December 12.....	57	35.63	103	102	63.73	1	0.60	160
December 20.....	47	42.73	63	63	53.27	0	0	110
December 29.....	81	40.50	116	116	58.00	0	0	197
1939								
January 6.....	54	38.43	86	86	61.57	0	0	140
January 14.....	71	39.44	109	108	60.00	1	0.56	180

TABLE 2.—*Monthly averages of sponge-bearing alimaño, from February, 1938, to January, 1939.*

Month. 1938	Sponge-bearing. Per cent.
February	2.51
March	1.86
April	0.64
May	3.88
June	20.91
July	20.73
August	36.56
September	14.40
October	3.49
November	0.50
December	0.61
1939	
January	0.56

group of eggs. These eggs, in all probability, do not form the subsequent aligui. New batches of eggs are probably developed at the next molting. It has been found that the alimaño die a few days after spawning. In caging experiments 52 female crabs died three to five days after spawning. It is therefore presumed that the female alimaño lays one batch of eggs and dies shortly after. Twenty-four spent alimaño which were kept in float cages were transferred into wooden coops, measuring 2 by 2 meters. The crabs were fed two or three times a day with bits of either mullet or ambassid. It was hoped that some of these crabs might survive until the following spawning activity to test the question of spawning more than one batch of eggs. It was found that all the crabs died within an average of about seven days interval after spawning.

HATCHING

On a sponge-bearing crab a ventral portion of the body is converted into a nest for approximately 2,000,000 eggs. The abdomen forms the floor of this nest. The exopodites of the swimmerets lend support by holding intact eight lobes of eggs in a fingerlike grasp. The endopodites serve as a quill-like rachis with fine threads to which adhere minute orange-hued eggs. These threads decrease in length and in the number of eggs they carry in relation to the decrease in width of the endopodite as it tapers to its apex. There are five rows for each endopodite with an average of 145 eggs per thread. The whole mass somewhat resembles a cauliflower without a central base.

The closest counting made showed that there are from 1,900,000 to 2,012,000 eggs in a sponge of the usual size. Two sponge-bearing crabs were used in this determination, measuring 78 by 117 and 85 by 131 millimeters.

The eggs are carried upon the swimmerets while development goes on. About 17 days are required for the eggs to hatch. When laid the eggs have already developed into the blastula stage. Segmentation of the eggs takes place internally, probably as they pass through the sperm sacs of the female. As fertilized eggs cease to grow further when reared in watch glasses and petri dishes, the stages leading to the formation of the embryo were not noted. There was no opportunity to observe the complete larval growth, especially the beginning and concluding stages of development. Every day the different stages of growth were carefully recorded and sketched with the aid of a compound microscope. Newly laid eggs are orange, but they become almost black as the hatching time approaches. The subsequent stages of growth, the gastrula and the early egg-zœa stages, are retained by the mother crab.

The eggs hatch into a free-swimming zœa larva (Plate 1, figs. 5 and 6), leaving a soft translucent egg capsule still attached to the individual hairs of the endopodites. The early stages of growth, as shown in Plate 1, figs. 5 and 6, were taken from one mother crab. The free-swimming egg-zœa larvæ were taken with the aid of a plankton net from the float cage where this crab was kept.

Hatching was conducted throughout the year, but no zœa larvæ were observed to molt into the megalop stage. As has been stated in the preceding discussion, the crabs normally spawn in the sea. Unsuccessful hatching in brackish waters may be attributed to the abrupt fluctuations of water temperatures and salinity. Water pollution, which occasionally besets the river, may also prevent the complete larval growth of the zœa larvæ. Of these factors, the variability of water temperature offers the greatest harm.

BIOLOGICAL MINIMUM SIZE

It was not possible to determine the exact age of the alimañgo at sexual maturity, because there was no opportunity to observe the complete larval growth. However, two crabs, A, measuring 6 by 9 mm, and B, 9 by 12 mm, collected from their natural habitats, were reared in confinement to determine the intervals

between molts and the size at sexual maturity. Table 3 shows that crabs A and B attained the biological minimum size after eleven and twelve successive molts, respectively, or at an average age of 149 days. The average biological minimum size of these crabs was 84 by 122.5 millimeters. The average increase in size per molt of crab A was 4.9 by 8.5 millimeters, while that of crab B was 5.4 by 9.3 millimeters. Allowing a month to complete the molting process of the zoea larvæ and their metamorphosis, crab B will probably attain the biological minimum size after molting from twelve to fifteen times, a period covering approximately 186 days.

TABLE 3.—Increase in size of crabs A and B in captivity following each molt.

Date.	Size.				Increase.		Intervals between molts.	Remarks.
	Shell.		Meat.					
	Length.	Width.	Length.	Width.	Length.	Width.		
1938	mm.	mm.	mm.	CRAB A. mm.	mm.	mm.	Days.	
August 9.....	9	12	14	17	5	5		
August 19.....	15	21	18	28	3	7	10	
August 28.....	20	31	24	37	4	6	9	
September 10.....	25	38	29	43	4	5	12	
September 30.....	31	44	36	54	5	10	10	
September 31.....	37	56	41	63	6	7	11	
October 12.....	43	65	47	72	4	7	12	
October 25.....	51	75	55	85	4	10	13	
November 7.....	56	87	62	94	6	8	13	
November 30.....	63	95	68	103	5	8	23	
December 28.....	70	104	78	115	8	11	28	Sexually mature in 142 days.
Average.....					4.9	8.5	13.0	
				CRAB B.				
September 5.....	6	9	8	12	2	3	1	
September 14.....	8	12	15	21	7	11	9	
September 24.....	16	21	20	30	4	9	10	
October 2.....	20	31	26	38	6	7	8	
October 10.....	29	40	36	50	7	10	8	
October 21.....	37	52	41	59	4	7	11	
November 1.....	43	61	49	70	6	9	11	
November 15.....	51	73	57	85	6	12	14	
November 29.....	60	86	67	96	7	10	14	
December 15.....	70	96	78	105	8	9	16	
1939								
January 1.....	82	105	88	112	6	7	17	Sexually mature in 156 days.
January 24.....	88	113	90	130	2	17	24	
Average.....					5.4	9.3	13.0	

In order to verify this finding, 559 crabs, measuring on the average 20.5 by 31.5 mm, were placed in captivity December 8, 1938. Table 4 shows that 25 crabs were recovered from this number and measured at seven and fifteen-day intervals, from December 16, 1938, to February 11, 1939, and from March 1, 1939, to May 2, 1939, respectively. The crabs were returned to the pond immediately after the necessary data were taken. Beginning April 2, 1939, the majority of the female crabs included in the catch had already attained the biological minimum size. The sizes of these sexually mature crabs were 69 by 105 and 93 by 123, or an average of 81 by 114 millimeters. The majority of the 559 crabs, therefore, became sexually mature after about five months.

The female can easily be distinguished externally from the male alimaño by the difference in size and shape of the abdomen or belt—that of the female is either triangular-shaped or with a broad, rounded form, while that of the male is \perp -shaped. The external character of either a male or a female alimaño manifests itself at an average size of 20 by 31 millimeters. Below this size group the structure and shape of the belt in both male and female are identical, so that sex cannot be determined externally.

MIGRATION

The alimaño is frequently found in waters that are slightly brackish or even quite fresh. From June to August a seemingly inexhaustible supply of young alimaño is found at the mouths of the rivers adjoining Manila Bay. The presence of these vast numbers of young and sponge-bearing crabs along the shore line and the mouths of rivers during the spawning season is of sufficient interest to merit special discussion.

Sponge-bearing crabs may be encountered in fishponds or in rivers, but the newly hatched alimaño has never been reported to occur anywhere except at mouths of rivers or along the shoreline. The absence, therefore, of the newly hatched crabs in brackish fishponds and in rivers during the spawning activity leads to the conclusion that the sponge-bearing alimaño occurring in these places normally migrate to their ideal breeding grounds to spawn. Lending further evidence to support this contention is the fact that a high percentage of sponge-bearing crabs are caught along the shore line and the mouths of rivers during spawning activity. Table 2 shows that the peak of

TABLE 4.—Relative rate of growth and size at sexual maturity of 559 crabs placed in captivity December 8, 1938, in rearing ponds 4, 5, 6, and 7.

November 8, 1938.				November 16, 1938.				December 22, 1938.			
Measured at 7-day intervals.											
Sample.	Length.	Width.	Sex.	Sample.	Length.	Width.	Sex.	Sample.	Length.	Width.	Sex.
1	31	43	males	1	24	35	virgin females.	1	31	55	virgin females.
2	27	40	do	2	36	55	do	2	47	73	males.
3	36	54	virgin females	3	17	25	sex not definable	3	35	52	virgin females.
4	20	29	males	4	9	15	do	4	37	56	Do.
5	37	58	virgin females	5	31	49	males	5	33	53	Do.
6	19	29	males	6	36	55	virgin females	6	9	12	sex not definable.
7	17	25	sex not definable	7	36	55	do	7	10	14	Do.
8	11	16	do	8	12	17	sex not definable	8	20	29	males.
9	8	14	do	9	9	15	do	9	35	54	virgin females.
10	6	12	do	10	8	11	do	10	9	12	sex not definable.
11	7	9	do	11	8	14	do	11	6	9	Do.
12	8	11	do	12	9	12	do	12	9	12	Do.
13	8	11	do	13	11	14	do	13	10	16	Do.
14	18	28	do	14	10	12	do	14	12	17	Do.
15	9	12	do	15	8	11	do	15	16	16	Do.
16	8	10	do	16	20	29	do	16	10	15	Do.
17	10	15	do	17	10	16	do	17	14	21	Do.
18	10	13	do	18	10	15	do	18	11	15	Do.
19	8	10	do	19	11	17	do	19	11	15	Do.
20	8	10	do	20	10	15	do	20	11	16	Do.
21	8	11	do	21	10	14	do	21	19	28	males.
22	8	11	do	22	10	14	do	22	13	19	sex not definable.
23	9	13	do	23	8	12	do	23	9	14	Do.
24	10	13	do	24	8	10	do	24	11	16	Do.
25	11	16	do	25	8	10	do	25	14	21	Do.

TABLE 4.—Relative rate of growth and size at sexual maturity of 559 crabs placed in captivity December 8, 1938, in rearing ponds 4, 5, 6, and 7—Continued.

Measured at 7-day intervals.				
December 31, 1938.				
Sample.	Length. mm.	Width. mm.	Sex.	
1	52	33	virgin females	
2	9	14	sex not definable	
3	32	49	virgin females	
4	35	55	do	
5	39	60	males	
6	33	52	do	
7	37	53	virgin females	
8	13	18	sex not definable	
9	12	16	do	
10	9	14	do	
11	27	38	virgin females	
12	25	38	do	
13	29	43	males	
14	25	37	do	
15	25	39	do	
16	23	38	virgin females	
17	23	35	do	
18	16	23	sex not definable	
19	21	32	males	
20	20	30	virgin females	
21	15	24	sex not definable	
22	19	30	males	
23	14	21	sex not definable	
24	15	23	do	
25	35	54	virgin females	
January 7, 1939.				
Sample.	Length. mm.	Width. mm.	Sex.	
1	45	69	virgin females	
2	43	65	do	
3	45	67	males	
4	41	63	virgin females	
5	29	42	males	
6	53	82	virgin females	
7	45	68	males	
8	49	74	virgin females	
9	14	20	sex not definable	
10	18	23	do	
11	29	43	virgin females	
12	27	40	males	
13	20	32	virgin females	
14	39	60	do	
15	32	49	males	
16	39	56	virgin females	
17	37	53	males	
18	18	28	sex not definable	
19	29	42	virgin females	
20	31	55	do	
21	17	25	sex not definable	
22	20	29	virgin females	
23	31	48	do	
24	33	52	do	
25	18	28	sex not definable	
January 14, 1939.				
Sample.	Length. mm.	Width. mm.	Sex.	
1	44	64	males	
2	58	87	Do.	
3	45	71	Do.	
4	48	73	virgin females.	
5	40	61	Do.	
6	39	56	Do.	
7	55	82	Do.	
8	61	93	Do.	
9	45	69	Do.	
10	42	63	males,	
11	43	63	virgin females.	
12	45	67	Do.	
13	46	69	Do.	
14	31	49	males.	
15	40	60	virgin females.	
16	45	69	males.	
17	36	53	virgin females.	
18	31	49	Do.	
19	37	58	Do.	
20	53	80	Do.	
21	53	81	Do.	
22	46	69	Do.	
23	52	79	Do.	
24	47	69	males.	
25	47	73	virgin females.	

Measured at 7-day intervals.							
January 21, 1939.				January 28, 1939.			
Sample.	Length.	Width.	Sex.	Sample.	Length.	Width.	Sex.
	mm.	mm.			mm.	mm.	
1	41	61	males.	1	45	70	virgin females.
2	46	71	virgin females.	2	39	59	males.
3	59	89	do.	3	50	77	do.
4	51	72	do.	4	45	71	virgin females.
5	34	50	do.	5	39	56	do.
6	51	80	do.	6	48	75	males.
7	32	50	do.	7	53	82	virgin females.
8	48	72	do.	8	52	79	do.
9	46	70	do.	9	55	87	do.
10	50	77	males.	10	64	97	do.
11	58	88	virgin females.	11	52	73	do.
12	61	92	males.	12	47	69	males.
13	47	73	virgin females.	13	31	49	virgin females.
14	35	52	males.	14	46	70	do.
15	56	85	virgin females.	15	45	69	males.
16	48	75	males.	16	61	93	virgin females.
17	47	72	do.	17	47	73	do.
18	41	71	virgin females.	18	45	73	males.
19	40	71	do.	19	53	81	virgin females.
20	42	71	do.	20	52	79	do.
21	45	68	males.	21	33	52	do.
22	46	69	virgin females.	22	41	63	do.
23	63	97	do.	23	45	67	males.
24	48	75	males.	24	61	94	virgin females.
25	37	58	virgin females.	25	50	78	do.

February 4, 1938.							
Sample.	Length.	Width.	Sex.	Sample.	Length.	Width.	Sex.
		mm.			mm.	mm.	
			males.	1	37	59	males.
			Do.	2	50	75	Do.
			Do.	3	58	91	Do.
			Do.	4	41	62	Do.
			virgin females.	5	52	82	virgin females.
			Do.	6	53	90	Do.
			Do.	7	46	70	Do.
			Do.	8	56	85	Do.
			Do.	9	54	82	Do.
			Do.	10	38	57	Do.
			Do.	11	56	85	Do.
			Do.	12	67	101	Do.
			Do.	13	51	73	Do.
			Do.	14	59	90	Do.
			Do.	15	59	88	Do.
			Do.	16	48	72	Do.
			Do.	17	67	102	Do.
			Do.	18	60	88	Do.
			males.	19	53	77	males.
			virgin females.	20	59	90	virgin females.
			males.	21	67	98	males.
			virgin females.	22	51	73	virgin females.
			Do.	23	55	85	Do.
			Do.	24	52	83	Do.
			Do.	25	51	73	Do.

TABLE 4.—Relative rate of growth and size at sexual maturity of 559 crabs placed in captivity December 8, 1938, in rearing ponds 4, 5, 6, and 7—Continued.

Measured at 15 day intervals.															
February 11, 1939.					March 1, 1939.					March 16, 1939.					
Sample.	Length.	Width.	Sex.		Sample.	Length.	Width.	Sex.		Sample.	Length.	Width.	Sex.		
	mm.	mm.				mm.	mm.				mm.	mm.			
1	62	94	virgin females.	1	53	81	virgin females.	1	62	93	males.	1	62	93	males.
2	57	86	males	2	66	99	do.	2	67	98	Do.	2	67	98	Do.
3	60	90	do	3	60	87	males	3	71	106	Do.	3	71	106	Do.
4	66	99	virgin females	4	64	95	do.	4	68	97	virgin females.	4	68	97	virgin females.
5	52	81	do	5	59	88	virgin females	5	67	98	Do.	5	67	98	Do.
6	50	77	do	6	62	92	males	6	57	88	Do.	6	57	88	Do.
7	52	79	males	7	58	87	virgin females	7	72	104	Do.	7	72	104	Do.
8	60	89	virgin females	8	53	89	do.	8	63	91	Do.	8	63	91	Do.
9	58	81	males	9	65	100	do.	9	66	99	Do.	9	66	99	Do.
10	59	90	do	10	64	101	do.	10	54	82	Do.	10	54	82	Do.
11	51	77	virgin females	11	66	98	do.	11	67	101	Do.	11	67	101	Do.
12	43	65	males	12	58	88	sexually mature females	12	68	103	Do.	12	68	103	Do.
13	52	78	virgin females	13	69	105	males	13	63	95	males.	13	63	95	males.
14	70	105	males	14	63	98	do.	14	76	116	sexually mature females.	14	76	116	sexually mature females.
15	56	84	virgin females	15	50	71	do.	15	72	105	virgin females.	15	72	105	virgin females.
16	43	64	do.	16	57	86	virgin females	16	69	107	Do.	16	69	107	Do.
17	66	98	do.	17	66	104	do.	17	65	97	Do.	17	65	97	Do.
18	44	75	males	18	64	95	do.	18	72	102	Do.	18	72	102	Do.
19	59	90	do.	19	58	87	do.	19	69	104	Do.	19	69	104	Do.
20	67	104	do.	20	65	100	do.	20	73	106	males.	20	73	106	males.
21	56	85	do.	21	69	103	do.	21	71	108	virgin females.	21	71	108	virgin females.
22	66	99	do.	22	58	89	males	22	68	97	males.	22	68	97	males.
23	58	89	males	23	62	92	do.	23	72	103	virgin females.	23	72	103	virgin females.
24	60	89	virgin females	24	57	87	virgin females	24	70	104	males.	24	70	104	males.
25	53	77	males	25	66	105	do.	25	67	99	virgin females.	25	67	99	virgin females.

Measured at 15-day intervals.

April 2, 1939.				April 17, 1939.				May 2, 1939.			
Sample.	Length.	Width.	Sex.	Sample.	Length.	Width.	Sex.	Sample.	Length.	Width.	Sex.
1	76	mm.	sexually mature females.	1	77	mm.	sexually mature females.	1	72	mm.	males.
2	75	114	males.	2	67	103	virgin females.	2	83	122	Do.
3	72	101	virgin females.	3	88	128	sexually mature females.	3	73	110	sexually mature females.
4	80	119	sexually mature females.	4	83	121	do.	4	86	120	Do.
5	83	125	do.	5	76	113	do.	5	72	109	Do.
6	83	123	males.	6	72	106	males.	6	74	110	males.
7	78	108	sexually mature females.	7	68	100	virgin females.	7	81	120	sexually mature females.
8	69	98	virgin females.	8	72	105	sexually mature females.	8	90	120	Do.
9	70	100	sexually mature females.	9	68	100	virgin females.	9	75	114	Do.
10	66	99	virgin females.	10	73	109	sexually mature females.	10	76	114	Do.
11	74	110	sexually mature females.	11	83	122	do.	11	88	127	Do.
12	62	88	virgin females.	12	88	135	do.	12	83	125	Do.
13	86	120	sexually mature females.	13	75	114	do.	13	75	114	Do.
14	92	123	do.	14	74	110	do.	14	92	122	males.
15	93	120	do.	15	72	105	males.	15	76	116	sexually mature females.
16	90	120	do.	16	74	111	sexually mature females.	16	69	105	virgin females.
17	72	108	do.	17	77	115	do.	17	81	110	sexually mature females.
18	75	114	do.	18	79	121	do.	18	71	104	Do.
19	74	110	males.	19	70	104	virgin females.	19	77	113	Do.
20	70	103	sexually mature females.	20	71	104	sexually mature females.	20	92	127	Do.
21	83	123	males.	21	80	116	males.	21	73	111	Do.
22	81	120	sexually mature females.	22	73	108	sexually mature females.	22	83	122	males.
23	70	99	virgin females.	23	77	115	do.	23	80	119	Do.
24	92	123	sexually mature females.	24	73	109	males.	24	86	125	sexually mature females.
25	73	108	do.	25	74	110	sexually mature females.	25	88	131	Do.

spawning activity of the alimaño is from the last week of May to the third week of September. The average monthly percentages of sponge-bearing alimaño are enumerated in Table 2.

A plankton net towed along the shore line and mouths of rivers during this season will catch the zœa and megalop stages of the alimaño. On the other hand, none of the embryonic stages of the crabs are found by simultaneous plankton towing in rivers and in baños fishponds. The zœa and the megalop stages reared in captivity with river and fishpond water usually die. It is presumed that the abrupt fluctuation of temperature and salinity of the brackish water in rivers and in fishponds is responsible for this failure.

Immediately after hatching the young crabs, like the majority of the marine larval fishes, come inshore or into brackish waters for active feeding. As a matter of fact, young crabs measuring from 11 by 16 to 31 by 48 millimeters, or an average of 21 by 27 millimeters, appear abundantly in rivers about the last week of September, a period which marks the decline of the spawning activity. Table 3 shows that the weekly percentages of sponge-bearing alimaño is comparatively low from October to May.

The rate of migration of the newly hatched crabs from the sea upstream is effected by the tide. It has been reported by the leading crab fishermen of the towns of Malabon and Navotas, Rizal Province, that big swarms of young crabs are sometimes left exposed on the mud at ebb tide. Continuous rise and fall of the river water helps them cover the long distance from the sea up the rivers. Further proof that the direction of migration of the young crabs is from the sea to the brackish waters is the fact that extensive fishing takes place first along the shore line and the mouths of rivers, and later on in the interior. Extensive fishing in rivers for both the young and mature alimaño is begun about a month after the close of spawning activity. After December there is hardly any crab fishing in rivers, because of the depletion of the supply. Crab fishing in rivers is resumed early in August and extends to December.

CULTIVATION IN CAPTIVITY

The alimaño easily responds to cultivation in captivity. This crab is hardy and will grow and stay healthy when kept in brackish fishponds with baños. The alimaño is comparatively cheaper and easier to raise than the baños. Many major problems, such as the securing of fry and food, and the presence

of enemies and water pollution, are often met with in the culture of baños. The alimaño normally thrive in very shallow ponds or even on quite exposed mud bottoms, a condition known to be fatal in baños culture. The culture, therefore, of the alimaño with the baños will increase the income of brackish fishponds per unit area.

METHOD

The alimaño should be reared in deeper compartments to thwart its natural instinct of burying in the mud, especially through the walls of the dikes. At low tide the alimaño digs through the mud, apparently to conceal itself or to avoid excessive exposure to heat. A hole through the dike is considered a major loss in the baños fishpond project.

December 8, 1938, 559 immature crabs, measuring on the average 20.5 by 31.5 millimeters, were raised in rearing ponds 4, 5, 6, and 7. These compartments are deeper by almost 2 feet than the rest of the rearing ponds. The crabs were purchased at one peso² per hundred. Of this number, 86 were recovered by means of bintol. They were sold at from 10 to 15 pesos per hundred.

These crabs were not fed, because the rearing ponds were not adequately provided with efficient gates to prevent the free passage of the crabs from one compartment into the other. Besides that, carnivorous species which were not completely eradicated, like the gobies, therapons, tarpons, and tenpounders, must have altered the results of feeding. It is hoped, however, that fish meal, given at least once a week, will perhaps result in the production of larger crabs. In the molting experiment the crabs fed once a week became sexually mature at an average of 84 by 122.5 millimeters. On the other hand, unfed crabs raised in the rearing ponds became sexually mature at an average size of 70 by 108 millimeters.

CONCLUSIONS AND RECOMMENDATIONS

1. The alimaño is the most important commercial crab in the Philippines. It is especially abundant in brackish waters adjoining the sea.
2. The alimaño is both carnivorous and herbivorous, a scavenger and a cannibal.
3. Growth is accomplished when this crab molts. The average increase in size per molt is 5.1 by 8.9 millimeters.

² One peso equals 50 cents United States currency.

4. Autotomy, the throwing off of appendages with consequent regeneration, is characteristic of the alimaño.

5. Internal fertilization occurs in the alimaño. Mating occurs at the time of the last molting, when the female changes the shape of the abdomen from a triangular to a broad, rounded form, and while the shell is still soft. This is probably the last molting.

6. The crabs spawn throughout the year. Spawning activity is at its peak between the last week of May and the third week of September. When the alimaño is about to spawn it is fat and generally sluggish. The abdomen is swollen and vascular. It is recommended that no crab fishermen catch female alimaño in their natural habitat during the peak of spawning activity.

7. The eggs from which the young are hatched are borne upon the individual hairs of the endopodite. There are about 2,000,000 eggs in an average-sized sponge. About 17 days are required for the eggs to hatch. It is recommended that further study be made on the hatching processes of this crab.

8. Sponge-bearing crabs migrate from the rivers or brackish water to the sea to spawn. The young crabs come inshore or into brackish waters for feeding and shelter. All crabs die within an average of about 7 days after spawning.

9. Extensive fishing in rivers for both young and mature alimaño commences about a month after the close of spawning activity. From December to May there is hardly any crab fishing in rivers because of the serious depletion of the supply.

10. The female alimaño attains the biological minimum size at an average of 84 by 122.5 millimeters. The crab molts from 12 to 15 times within a period of approximately 186 days.

11. The alimaño easily responds to cultivation in captivity. The crabs should be harvested on or before the formation of the aligui. At this age they are fat and command a better price in the local markets.

12. It is recommended that no crab fishermen be allowed to catch female crabs with triangular-shaped abdomen and males below 84 by 122 millimeters.

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ILLUSTRATIONS

PLATE 1

- FIG. 1. Bintol.
2. Sakag.

PLATE 2

A female crab in the process of molting.

PLATE 3

- FIG. 1. An egg in the blastula stage.
2. Egg zœa just before hatching.
3. Egg zœa bursting from the egg cell.
4. Egg capsules still attached about the individual hair of the swimmerets.
FIGS. 5 and 6. Free-swimming first zœa larva.
FIG. 7. Lateral view of second zœa larva.

TEXT FIGURE

- FIG. 1. The hook (panukot) employed to catch alimañgo.



1



2

PLATE 1.



PLATE 2.

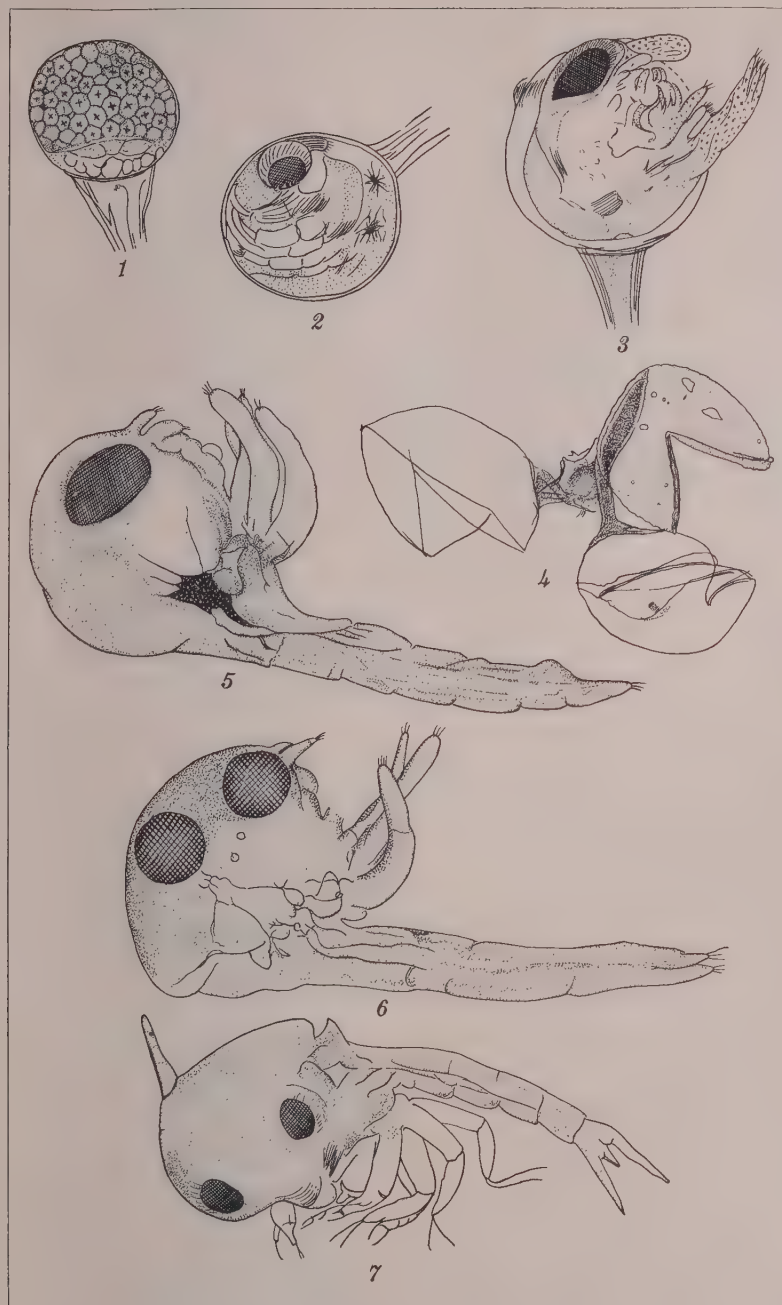


PLATE 3.

NOTES ON HYMENOPHYLLACEÆ¹

By EDWIN BINGHAM COPELAND
Of the University of California, Berkeley

FOUR PLATES

MICROTRICHOMANES DICHOTOMUM (Kunze) Copeland.

DUTCH NEW GUINEA, 18 kilometers southwest of Bernhard Camp, Indenburg River; epiphytic in mossy forest. *Brass* No. 12702.

New to New Guinea. Larger and more symmetrically dichotomous than most Java specimens, the frond being 16 cm long exclusive of stipe. The tube has the characteristic form, narrower than that of *M. digitatum*.

MICHOTRICHOMANES ARMSTRONGII (Baker) Copeland comb. nov.

Trichomanes Armstrongii BAKER, Syn. Fil. (1868) 452.

MECODIUM ATROVIRENS (Col.) Copeland comb. nov.

Hymenophyllum atrovirens COLENSO, Tasm. Journ. Nat. Sci. 3 (1844) 186.

Specimens of this species and of *Mecodium australe* (Willd.), sent me from New Zealand by Professor J. E. Holloway, seem very distinct, *M. atrovirens* being smaller, narrower throughout, and much darker, with conspicuous 2-cells-thick margin. *M. atrovirens* is not equally distinct from *M. australe* of Tasmania, whence the latter species was described; but the two are too different in New Zealand to be regarded as forms of a single species. It is possible that I select the wrong plant to bear a different name.

MERINGIUM MINIMUM (A. Rich.) Copeland comb. nov.

Hymenophyllum minimum A. RICHARD, Fl. Nouv. Zél. (1832) 91, pl. 14, fig. 2.

Excellent material from Professor Holloway shows the receptacle so constantly and so far protruding that the propriety of

¹ This paper includes the second report on the ferns collected by the Third Archbold Expedition to New Guinea. The first report was published in Philip. Journ. Sci. 73 (1940) 345.

treating this dwarf as a *Meringium* is evident. It may well be remembered, not only that distinctions may become inconspicuous with dwarfing, but also that *Meringium* in its full and typical development is a New Guinea-Malayan genus, and that in New Zealand and America, nearer to the common Antarctic ancestral source, it is always less distinct from *Hymenophyllum*.

MECODIUM NOVOGUINEENSE (Ros.) Copeland comb. nov.

Hymenophyllum Blumeianum Spr. var. *novoguineensis* ROSENSTOCK, Fedde's Repert. 5 (1908) 371.

Hymenophyllum polyanthos COPELAND, Philip. Journ. Sci. 64 (1937) 103, non Swartz.

Varietas frondibus 3-4-pinnatifidis, quam in typo reperiuntur c. quintuplo majoribus (70 cm vel ultra longis, 6-10 cm latis), pinnis primariis saepissime extra ordinem elongatis, ultrapedalibus a typo diversa.

—ROSENSTOCK, loc. cit.

DUTCH NEW GUINEA, altitude 1,600 to 2,800 meters, *Brass Nos.* 10578, 11503, 12724.

In my "*Hymenophyllum*"² are cited several collections from Dutch as well as from German New Guinea. Brass's specimens vary in length from 30 to 70 cm, all having the irregular branching, most conspicuous in the distal part of the frond, which is as characteristic of the species as is its size. The shape of the sorus (lips) is not distinctive. It remains true that inconvenience results from the recognition of a species which cannot always be distinguished from another, presumptively its parent species. Still, species are commonly characterized in their full development, and the ability to achieve the size and form now familiar by many collections of this species is sufficient distinction from *M. polyanthos*. No less inconvenience results if *M. polyanthos* is so defined as to include this locally well-established giant. *Brass 12169* is identified as *M. polyanthos*; but it is likely to be an individual of *M. novoguineense*, too young or for some other reason too weak to develop the fronds characteristic of that species.

MECODIUM ARCHBOLDII Copeland sp. nov. Plate 1.

M. longifolio adspectu simile, potius *M. involucrato* affine, rhizomate stipiteque 5 cm longo nigro nudo vix sursum alato filiformibus; fronde varia, nunc 20 cm vel ultra longa, 3.5 cm lata, nunc lineare 2 cm lata, nunc tandem irregulare ambitu majore tripinnatifida, rhachi anguste alata, pinnulis truncatis

² Tom. cit. pp. 103, 104.

haud profunde fissis, segmentis vix 1 mm latis brevibus emarginatis viridibus; soris copiosis, utroque latere pinnae ad segmenta terminalibus, involucri 1.5 mm longo, tubo ramis venae sustenso conspicue alato, labiis obtuse triangularibus integris, receptaculo gracile incluso.

DUTCH NEW GUINEA, Bernhard Camp of Third Archbold Expedition, Idenburg river, altitude 50 meters, "massed on trees in deeply flooded rain forest." *Brass* No. 14067.

Like *M. involucriatum* in having the sori subtended by evident vein branches and broadly winged to the top of the obconic tube, but distinct in having much larger but less deeply dissected fronds, and more elongate, less rounded lips. *M. longifolium*, more similar to the present species in gross appearance, has broad sori with massive receptacles.

MECODIUM BISMARCKIANUM (Christ) Copeland comb. nov.

Hymenophyllum bismarckianum CHRIST in Schum. & Laut., Nachtr. Fl. deut. Schutzgeb. in der Südsee (1905) 34; Philip. Journ. Sci. § C 2 (1907) 154.

DUTCH NEW GUINEA, *Brass* Nos. 9250, 10515, 10628, 11236, altitude 2,300 to 3,225 meters, pendent from trees except at the greatest altitude, there under rocks. Previously reported from this region by Ridley, Trans. Linn. Soc. Bot.

Identified by description, but with confidence, every item of Christ's short description being distinctive and appropriate, as is his later remark on the resemblance to *M. thuidium*. He confused *Meringium denticulatum* and *M. acanthoides*; it is the latter to which this has much superficial resemblance. The sori are minute indeed, about 0.6 mm long and wide, the smallest known in the family. The fronds of some specimens branch irregularly, as do those of *M. novoguineense* and *M. Brassii*.

MECODIUM OOIDES (F. V. M. & Baker) Copeland.

Following Christensen's interpretation,³ because it is based on comparison with the type, I so identify *Brass & Myer-Drees 10204*, "North slope of Mount Wilhelmina, 2,150 meters alt. Alpine grassland; massed on sides of rocks (sandstone)." This is an Alpine dwarf, fronds mostly 3 to 4 cm long, 4 mm wide, the pinnae or segments secund, oblong, exceedingly densely imbricate and almost concealing the abundant sori. Two fronds have some pinnae elongate and simulating the main axis. Mrs. Clemens sent the same species twice from Mount Sarawaket,

³ *Brittonia* 2 (1937) 273.

altitude 8,000 to 10,000 feet, very freely branched, and with the segments less compactly imbricate.

This species has no resemblance nor near affinity to the species to which I applied the name in my monograph of the genus.⁴ There is resemblance and affinity to *M. mnioides* (Baker) Copel. of New Caledonia, but the sori of *M. ooides* are not evidently subtended by forks of the vein.

MECODIUM BADIUM (H. & G.) Copeland.

Stipe 14 cm long; lamina 26 cm long, 13 cm broad; typical except for great size. Already reported from New Guinea by Gepp, and by Ridley.

MERINGIUM GORGONEUM Copeland.

Hymenophyllum serrulatum var. *cristulatum* cum fo. minor ROSENSTOCK.

H. meyenianum COPELAND quoad plantas neoguineenses, Philip. Journ. Sci. 64 (1937) 28.

Brass 10627, Lake Habbema, altitude 2,800 meters.

The *Brass* specimen is large, up to 18 cm long and 7 cm broad, and the lowest pinnæ are reduced; still, I think this determination is preferable to calling it *M. meyenianum* or designating it as a new species. The Bamler specimens, *Ros. Fil. novoguine. exsic. No. 209*, and *Bamler 50d*, are small and deltoid, but like *Brass*'s in the conspicuous crests on the back of the tube, and in structure. These crests seem to be constant in New Guinea material, and seem to demand removal from *M. meyenianum*, to which the affinity is clear. My specimens of *Ros. Fil. novoguine. exsic. No. 342*, *Copland King B 31*, and an unnumbered collection by Arndt, are all sterile. *Brass* 10627 and *King B 31* approach typical *M. gorgoneum* in the prominence of the marginal teeth. *Brass* 13366, altitude 850 meters, and 12071, altitude 1,800 meters, have narrower segments, are therefore more lax in aspect, and have distinctly less prominent teeth. Their affinity is here, but the specific identity is doubtful.

Finally, *Brass* 12665, altitude 2,150 meters, is intermediate between these and the macroglenoid plant I construe as *M. rubellum*, and looks as an hybrid should. It is very dark.

MERINGIUM RUBELLUM (Ros.) Copeland.

With imperfect confidence I give this name to a rich sequence of related specimens: *Brass* Nos. 12816 (altitude 1,200 meters), 12380 (1,500 meters), 12723 (1,600 meters), 12704 (2,000

⁴ Philip. Journ. Sci. 64 (1937) 107.

meters), 11237 (2,300 meters), 10657, 10702 (2,800 meters), 9107, 9298 (3,225 meters), and 9648 (3,400 meters). These are alike in very narrowly winged hairy rachis, in being tripinnatifid with forked segments, in small and few marginal teeth, in more or less reddish cell contents applied to a more or less (never conspicuously) reticulate-thickened wall, in rather large sori cleft hardly one-third of the way down, with entire lips, and the tube hairy and ribbed and usually cristate on the back. They vary in shape of frond, the basal pinnæ sometimes the largest, sometimes reduced; in the hairiness of the axes, sparsely or very densely clothed with coarse, crinite, articulate hairs, which in hairiest individuals extend to the laminar tissue; and in color, as 11237 is conspicuously red, 10702 and 9648 are blackish, the others brown tinged with red. Hair and crests are to some extent alternative ornaments of the tube, the most hairy tubes not being evidently cristate. The majority are remarkably suggestive of *Macroglena*; but the sure affinity is to *M. meyenianum*.

I am unable, by definition, to distinguish some of these specimens from *Hymenophyllum firmum* v.A.v.R., which they perhaps represent; however, the identity of *H. firmum* and *H. rubellum* seems not to have occurred to me when, several years ago, I had the type collections in hand for comparison.

Nos. 9648 and 10702 have short, broad fronds, and possibly represent *Hymenophyllum brevifrons* v.A.v.R., which I have never seen.

MERINGIUM LATIFOLIUM Copeland sp. nov. Plate 2.

Rhizomate stipitibusque 2.5 ad 4 cm altis filiformibus, fuscis, glabrescentibus, stipitibus supra medium anguste alatis; lamina ca. 4 cm alta, 3 ad 3.5 cm lata, tripinnatifida, rhachi anguste alata ala dentibus perpaucis munita, fusco-viride, glabra, segmentis 1 mm latis, apice dentatis alibi serratis dentibus argutis; parietibus interioribus cellularum leviter et irregulariter incrassatis, areolis sat magnis non incrassatis haud profundis exceptis; soris segmenta terminantibus, involucri 2 ad 2.5 mm longo, 1 mm lato, ad vel ultra mediam longitudinem fisso, labiis acutis vel obtusis integris, tubo deorsum immerso, dorso deorsum aut tuberculoso aut laeve, receptaculo protruso.

DUTCH NEW GUINEA, 18 kilometers northeast of Lake Habema, altitude 2,300 meters, *Brass* No. 11091 (type), in moss on base of tree; No. 13388, altitude 850 meters, common in rain forest undergrowth.

Distinguished by alate rachis and stipe, and small, broad fronds. In spite of the absence of crests or prominent ribs on the tube, this belongs in the general group of *M. holochilum*. In this group, *Hymenophyllum ellipticosorum* and *H. circinnatum* are described with winged stipe and rachis, both with comparatively narrow fronds, and both with pilose axes.

MERINGIUM ARCHBOLDII Copeland sp. nov. Plate 3.

Rhizomate stipiteque 8 ad 16 mm alto filiformibus, nudis, nigrescentibus; lamina 3.5 ad 5.5 cm longa, 1.1 ad 1.5 cm lata, viride, basi aut truncata aut attenuata pinnata, rachi basi terete, alibi late alata ala integra; pinnis infimis interdum remotis parvis simplicibus, sequentibus furcatis vel bis furcatis, segmentis ca. 2 mm latis, ellipticis, apice dentatis alibi serrulatis dentibus remotis parvis angustis acutis; parietibus interioribus cellularum valde reticulato-incrassatis; soris segmenta acroscopica abbreviata terminantibus, involucri usque ad 3 mm longo, ca. 1.3 mm lato, plus minusve ad mediam longitudinem fissio, labiis rotundatis integris, tubo ad basin imam immerso, deinde decrescenti-alato, dorso deorsum subnudo vel tuberculis inconspicuis aspero, receptaculo (in specimene) incluso.

DUTCH NEW GUINEA, 15 kilometers southwest of Bernhard Camp, Idenburg River, altitude 1,800 meters, *Brass No. 12328*, on a mossy tree.

Remarkable for the few and wide segments, and for the combination of green color and very thick, coarsely pitted walls. *M. herterianum* has segments nearly as wide. *Carr 13501* represents that species in better development than the type, the basal pinnæ being free, and the rachis wingless above them. Its walls are thin, or somewhat but evenly thickened, with no suggestion of broad pits; and the lips are conspicuously toothed. *Hymenophyllum ellipticosorum* v.A.v.R. is from the same region and about the same size, also with broad segments, but is described as with winged stipe and toothed lips.

MERINGIUM MELANOSORUM Copeland sp. nov. Plate 4.

Rhizomate gracile, ramoso, glabrescente, fusco nigrescente; stipitibus remotis, 1 ad 2 cm altis, filiformibus, teretibus, inconspicue et decidue piliferis; lamina 3 ad 5 cm longa, 2 ad 3 cm lata ob pinnas reflexas saepe angustiore adpectu, tripinnatifida pinnulis segmentisque paucis, mox glabrescente, costa alata ala dentis maximis ornata; segmentis 1.5 mm latis, dentibus paucis acutis conspicuis; parietibus cellularum marginalibus tenuissimis, caeteris tenuibus hic illuc leviter noduloso-

incrassatis, interaneis ferrugineis subhyalinis; soris axillaribus, praestantibus, involucro 3 mm longo, 1.5 mm lato, primo fusco mox nigrescente, brevi-bilabiato labiis integris late rotundatis rigidis; tubo tantum marginato, dorso primo plicifero plicis hic tantum piliferis alibi in dentes etenim in lobos liberos terminantibus, his appendiculis tum demum dejectis tubo tantum rugoso, receptaculo valida protruso nigro.

DUTCH NEW GUINEA, 2 kilometers east of top of Mount Wilhelmina, altitude 3,800 meters, *Brass & Myer-Drees No. 10327*, (type), "epiphytic in subalpine forest." In the same region, *Nos. 9172, 9602, 9797a, 9901, 9902, 10210*, least altitude 3,225 meters.

Apparently related to *M. firmum* (v.A.v.R.), and an Alpine representative of the general group of *M. holochilum*, as shown by the ribs, hairs, and crests on the tube. It is evidently common locally, but seems quite distinct from any known species.

MERINGIUM FOERSTERI (Ros.) Copeland comb. nov.

Hymenophyllum Foersteri ROSENSTOCK, Fedde's Repert. 12 (1913) 165; COPELAND, Philip. Journ. Sci. 64 (1937) 58, pl. 23.

Besides a cotype, I have now, from Mrs. Clemens, fully fruiting fronds, from Morobe district, altitude above 8,000 feet, February, 1939. The receptacle is long-extruded, fully twice as long as the involucre. More careful examination of the cotype shows one receptacle broken above the end of the lip. With this correction of the description I transfer the species to *Meringium*; but it is still an aberrant element in that genus. The hairs of the Clemens specimen are even denser than on the type collection, and somewhat paler in color. The rachis is only partly winged, my key⁵ being wrong in that respect; the original description reads "Interrupte marginatis."

MERINGIUM BRASSII (C. Chr.) Copeland comb. nov.

Hymenophyllum Brassii C. CHRIST, Brittonia 2 (1937) 273.

Brass Nos. 9106, 9249, 9299, 9345, all from Lake Habbema, altitude 3,225 meters, *10855*, altitude 3,100 meters; *10516, 10517*, altitude 2,900 meters; *12327*, altitude 1,800 meters.

Indeed, "it is a peculiar species." It is very near to my *Myriodon odontophyllum*,⁶ published two months later. The type of the latter has disappeared, so I cannot now reexamine it to make sure that the differences are real. All specimens of *M. Brassii*, including *Brass 4114*, the type collection, have con-

⁵ Tom. cit. p. 16.

⁶ Philip. Journ. Sci. 64 (1937) 73, pl. 35.

tinuous lamina on at least a part of the pinnules; if this was so of any pinnules of our specimen of *Ledermann* 19057, they were overlooked, as were also the curious, dark, opaque bristles, —“setis atropurpureis, cylindricis, plerisque curvatis, subulatis” of Christensen, if they were present. These vary from hardly present at all to exceedingly common on different collections of *M. Brassii*. They are variously placed, single or geminate, rarely branched; the most remarkable position is where a bristle stands squarely across the end of a foliar tooth, both ends usually recurved. On the main and secondary rachises the foliar teeth are discontinuous, and wherever they are crowded they stand in several planes.

The rhizome is nodose, most conspicuously so in dwarfed plants. From each “node” arise usually plural stipes, and often also branches of the rhizome which look like stipes, a phenomenon reminiscent of *Gonocormus*.

The plant is exceedingly plastic. No. 9299, “hanging from leaning trees in heavily mossed forest,” has a frond 60 cm long. The longest frond of No. 9249, “massed under a rock in forest,” reaches 7 cm. This plant has receptacles 12 mm long, 0.5 mm thick, nearly twice as thick as the rhizome.

Ultimately it will probably seem proper to include this species in *Myriodon*, or to reduce that genus to *Meringium*. I defer a decision, hoping that the type of *Myriodon* may be found. *Myriodon* can easily be redefined, to include *M. Brassii*, and *Meringium* to exclude it.

MERINGIUM BARTLETTII Copeland sp. nov.

Rhizomate tenuiter filiforme; stipite 2 cm longo, tereto, atrofusco, sparse et decidue fibrilloso; fronde 2.5 ad 3 cm alta, 1.5 ad 2 cm lata, rhachi deorsum plerumque tereta alibi anguste alata; pinnis adnatis (infima rarius libera), segmentis paucis (pinnarum inferiorum 3 ad 5), 1 ad 1.5 mm latis, apice rotundatis, argute serratis dentibus 0.25 ad 0.3 mm longis gracilibus divaricatis, costis decidue piliferis; parietibus cellularum vix incrassatis; soris ad partem apicalem frondis restrictis, ad pinulam quamque parenchymate plus minusve carentem 1 vel 2, ca. 2 mm longis, ad vel ultra medium involucrum fissis, tubo sparse piloso, labiis triangulari-oblongis, laciniato dentatis dentibus paucis, receptaculo extruso.

MINDANAO, “Palao Amopo (the ‘Sacred Hill’), northeastwardly across the Iligan River from Camp Keithley, Lanao Province.” *H. H. Bartlett* No. 15973, September 11, 1935.

Probably related to *M. holochilum*; but as a matter of resemblance, most like the Samoan *M. praetervisum* (Christ), from which it differs in broader-winged rachis and more prominent teeth, especially on the lips of the involucre.

AMPHIPTERUM HUMATOIDES Copeland sp. nov.

Rhizomate repente, 0.4 mm crasso, setis fuscis subdeciduis onusto; stipite vulgo 1.5 ad 3.5 cm alto, tereto, nigro-fusco, glabrescente; lamina vulgo 3 cm alta, ovata, pinnatifida; segmentis oblongis, integris, apice rotundatis, infimis maximis ca. 5 mm latis, basiscope interdum subauriculatis, coriaceis, fuscis, inferne sparse superne densius setosis; venis superne anguste trilamellatis lamellis totam laminam fere obtegentibus; cellulis laminae fere isodiametricis, parietibus anticlinis, poris latis exceptis, incrassatis soris in axillis segmentorum solitariis, involucre ca. 3 mm longo, parte tertia fisso, tubo obscure longitudinaliter corrugato sat dense piloso, labiis 2 mm latis, late rotundatis, integris, glabris, aterrimis, receptaculo extruso.

DUTCH NEW GUINEA, 18 kilometers southwest of Bernhard Camp, Idenburg River, altitude 2,150 meters, common on branches of tall trees, *Brass* No. 12638; also, same region, altitude 1,800 meters, No. 11867.

Besides such fronds as have just been described, the type bears one frond 5 cm long, 13 mm wide, without dilated base, its stipe 8 cm long; this may be the normal adult form; but I cannot so describe the species, having 8 fertile fronds which look like stunted *Humata repens*. The species is quite isolated. In texture it is similar to *A. geluense*, which bears lamellæ on both surfaces.

VANDENBOSCHIA "SCHMIDIANA (Zenker) Copel."

DUTCH NEW GUINEA, Idenburg River, altitude 1,200 meters, *Brass* No. 12932.

I do not suppose this identification to be correct, but have no reason except inherent improbability for rejecting it. The specimen is a generalized little plant, which, so far as structure goes, might be *Vandenboschia* or *Gonocormus*. More ample material might fix its place in the latter genus, in which it would be specifically new. It also suggests *V. latifrons* (*Trichomanes latifrons* v. d. B.⁷).

⁷ Ned Kruid. Arch. 5³ (1963) 209.

VANDENBOSCHIA ANGUSTATA (Carm.) Copeland comb. nov.

Trichomanes angustatum CARM., Trans. Linn. Soc. 12 (1818) 513.

Trichomanes tenerum SPR., Syst. Veg. 4 (1827) 129.

Vandenboschia tenera COPELAND, Philip. Journ. Sci. 67 (1938) 53.

I am indebted to Doctor Christensen for specimens of this species, leg. Dr. E. Christophersen, Inaccessible Island, February 3, 1938. It is not at all a *Macroglena*, as I have surmised; but is exactly *V. tenera*, as, indeed, was represented by Diels in Die Natürlichen Pflanzenfamilien.

PLEUROMANES RETUSUM Copeland sp. nov.

Rhizomate late repente stipiteque obscuro 5 ad 10 cm alto gracilibus nudis; fronde 10 ad 15 cm alta, ovata vel rarius lanceolata, tripinnatifida, rhachi deorsum terete; segmentis ultimis 1 mm latis vel paulo latioribus, apice inciso-emarginatis, glabris, pallide viridibus; margine hinc inde (non ubique) anguste incrassato, linea costale leviter incrassata angusta; involucre obconico, ca. 1.3 mm longo, aut medio aut fere omnino alato, receptaculo extruso.

DUTCH NEW GUINEA, 15 kilometers southwest of Bernhard Camp, Idenburg River, altitude 1,700 meters, *Brass No. 12204*. "Frequent low epiphyte in rain forest ravines; leaves pendent, glaucous."

Very near to *P. acutum* Presl, of Luzon; distinguished by the absence of a wing on the lower part of the rachis, by usually broader fronds, and by the deeply emarginate apices of the segments. If *P. acutum*, instead of being very uniform, were as variable as are many species of this family, it might well include this fern. The affinity is unmistakable and close.

PLEUROMANES PALLIDUM (Blume) Presl.

DUTCH NEW GUINEA, *Brass Nos. 12014, 9372, 10910*, altitude 1,800 to 3,260 meters. Fronds of *No. 10910* reach a length of 45 cm (cf. *Trichomanes savaiense* Lauterbach); its tubular, truncate involucre is 3 mm long. The involucre of *Pleuromanes* should receive some attention as also should the hairs, which vary widely.

CREPIDOMANES RUPICOLUM (Racib.) Copeland.

MINDANAO, Lanao Province, near Dansalan, *Bartlett 15915*. This is the first report from the Philippines, but I found the species near San Ramon in 1933.

My disposition has been to regard dwarfs in this group in the Philippines as forms of *C. brevipes*, however like they might

In this case the width of the segments and the paucity of false veins make this practice inadmissible. Bartlett's fronds are 1 to 1.5 cm long, the segments 2 mm wide. Dwarf forms of *C. brevipes* (*Didymoglossum anomalum*) are sometimes smaller, but always with narrower segments and abundant false veinlets.

CREPIDOMANES BREVIPES (Presl) Copeland.

DUTCH NEW GUINEA, Bernhard Camp, Idenburg River, altitude 50 meters, *Brass No. 13964*. New to New Guinea; quite distinct from *C. venulosum*, in that striæ are everywhere sparse, and particularly in their sparseness in the lips.

CONOCORMUS NOVOGUINEENSIS (Brause) Copeland comb. nov.

Trichomanes novo-guineense BRAUSE, Bot. Jahrb. 49 (1912) 7.

DUTCH NEW GUINEA, 9 kilometers northeast of Lake Habbema, altitude 2,800 meters, *Brass No. 10972*. Identified by description, to which the specimen conforms as well is to be expected in this genus. It is remarkable for very narrow wings on axes and segments, and for almost complete elimination of the lamina in the distal, soriferous parts. There is resemblance and probable close affinity to *G. alagense* (Christ).

SELENODESMIUM OBSCURUM (Blume) Copeland.

Brass brings in from the Third Archbold Expedition eight collections of *Selenodesmium*, of which two are typical *S. obscurum*, all the others more or less variant in the direction of deep dissection of the pinnules, as the laminar wing is more and more restricted. Finally, on *Nos. 12208* and *12831*, the laminar tissue is so far gone that the rachis is wingless throughout, and the secondary rachises of the upper part of the frond are marginate rather than winged. By definition, this upper part of the frond would be *Macroglena*; but the lower part is deeply dissected *Selenodesmium*, and the series of intermediate forms is too complete to make separation from *S. obscurum* convenient.

CEPHALOMANES OBLONGIFOLIUM Presl.

DUTCH NEW GUINEA, 4 kilometers southwest of Bernhard Camp, Idenburg river, altitude 850 meters, on rocks along small stream. *Brass No. 13367*. New to New Guinea, although reported from Amboyna and the Solomon Islands. The commonest species in the Philippines.

MACROGLENA SCHLECHTERI (Brause) Copeland.

DUTCH NEW GUINEA, Idenburg river region, *Brass Nos. 12790, 13314*, altitude 900 to 1,200 meters, the former with fronds up to 70 cm long, pendent from mossy branches.

ILLUSTRATIONS

[All plates are from photographs by W. C. Matthews.]

PLATE 1

Mecodium Archboldii Copeland sp. nov.; type.

PLATE 2

Meringium latifolium Copeland sp. nov.; type.

PLATE 3

Meringium Archboldii Copeland sp. nov.; type.

PLATE 4

Meringium melanosorum Copeland sp. nov.; type.



PLATE 1. MECODIUM ARCHBOLDII COPELAND SP. NOV.; TYPE.



PLATE 2. MERINGIUM LATIFOLIUM COPELAND SP. NOV.; TYPE.



PLATE 3. MERINGIUM ARCHBOLDII COPELAND SP. NOV.; TYPE.



PLATE 4. MERINGIUM MELANOSORUM COPELAND SP. NOV.; TYPE.

BOOKS

Books reviewed here have been selected from books received by the Philippine Journal of Science from time to time and acknowledged in this section.

REVIEWS

A. S. T. M. Standards on Petroleum Products and Lubricants. 1938. Philadelphia, American society for testing materials, 1938. 311 pp., illus. Price, \$2.

As in previous years, this publication of the American Society for Testing Materials standards on petroleum products and lubricants contains official definitions of terms relating to petroleum, specifications, methods of testing, and the Annual Report of Committee D-2 for petroleum products of the American Society for Testing Materials.

This yearly publication has not only served to standardize methods of test regarding petroleum and its products, but has also exercised a tremendous influence on research toward the evolvement of better and improved products.

This year's publication should be of interest to those who are engaged in the testing of petroleum products and lubricants, as several revisions and recommendations regarding standard and tentative standard methods of test have been included. Notable among these are those relating to Conradson carbon residue, Kinematic viscosity, Reid vapor pressure of petroleum products, and the ignition quality of Diesel fuels.

The book also contains an abridged volume correction table for various groups of petroleum oils, which should be useful to producers as well as to users of fuel and lubricating oils.—I. P.

A. S. T. M. Standards on Petroleum Products and Lubricants. September, 1939. Philadelphia, American society for testing materials, 1939. 336 pp., illus. Price, \$2.

This publication, as mentioned in the review above, is issued and revised annually by the American Society for Testing Materials. It contains definitions, specifications, methods of testing, charts, and tables relating to petroleum products and lubricants. The publication for 1939 also includes a report of the results of experiments conducted by the Society on the methods of determining the gum stability in, and the relation

of such tests to storage behavior of, gasoline. This report is quite significant considering the fact that different methods have been used to measure the potential gum-forming characteristics of gasoline with varying degrees of success.

This year's revision of the book also proposes a method of determination for tetraethyl lead in gasoline. The method employs concentrated hydrochloric acid to convert the lead into lead chloride, and the latter is determined either volumetrically by titration with ammonium molybdate or gravimetrically as chromate or sulfate.

Unlike the previous editions of this publication, this year's A. S. T. M. Standards on petroleum products and lubricants contains standard specifications for A. S. T. M. thermometers, which should serve as a very handy means for checking thermometers in use. As a whole, this book is a worthy revision of its predecessors.—I. P.

Evaluation of Petroleum Products. A Résumé of Present Information. Sponsored by Sectional Committee Z-11 on Petroleum Products and Lubricants. Philadelphia, American society for testing materials, 1940. 52 pp.

This publication is indeed a résumé of present information in the field of testing petroleum and its products. It is made up of six papers; namely, Lubricating oils, Petroleum lubricating greases, Gasoline, Diesel fuels, Fuel oils (other than Diesel), and the Status of research on fuels and Lubricating oils for spark-ignition aircraft engines.

The paper on lubricating oils gives a brief account of the types of service where considerable quantities of lubricating oils are used, such as in machine bearings, in automobile engines, and in other mechanical parts. Important oil properties, such as viscosity, viscosity index, oil stability, and others, are also covered, with a discussion of their test methods.

Under petroleum lubricating greases, the trend in research in this field covers the physical and chemical tests used as a means to predict the service performance of these products.

The paper on gasoline was written by T. A. Boyd, one of those who discovered tetraethyl lead, the most effective anti-knock dope so far known. This paper discusses primarily the tests applied to gasoline; such as volatility and its relation to power and consumption, and knock characteristics of gasoline, gum, and sulphur content.

Under Diesel fuels, fuel oils, and fuels and lubricating oils for spark-ignition aircraft engines, many subjects of great in-

terest to users and producers of and technologists in the fuel industry are discussed.

The pamphlet should prove of interest also to those who are actually engaged in the testing of petroleum products, as it brings together in a convenient form all the pertinent progress, problems, and present methods used in the evaluation of these products.

Finally, each paper also includes a good number of references which add value to the publication.—I. P.

Weather in the Making. By Dorothy Fisk. London, Faber and Faber Limited, 1939. 234 pp., front., illus., tables. Price, \$2.75.

This is another popular book on a subject which is always interesting. Without recourse to odd and unusual occurrences, Miss Fisk describes the ordinary processes of weather in a way that makes both instructive and entertaining reading. The contents of the book proceed in an orderly fashion, from a review of the motions of the earth, which has an influence on the weather, to the composition of the atmosphere, the factors which produce changes of pressure and temperature in the atmosphere, and the resulting winds, storms, clouds, rain, haloes, thunder, and other phenomena. The last two chapters are devoted to the problems of weather forecasting. The author is very encouraging to amateur forecasters, and at the same time is very honest in appraising the difficulties under which the professional forecaster labors and the chances of his forecast being verified.—L. W. W.

The Kandy Flora. By A. H. G. Alston. Colombo, Ceylon, Government press, 1938. 210 pp. Price, Rs3.50.

This well-illustrated book on the flora of Kandy covers 404 species, representing 273 genera that are typical representatives of 98 families of flowering plants. The author follows Hutchinson's scheme which includes several families that are merely generic groups under Engler's system. The descriptions are short, clear, and concise, and make the scheme especially suited to the author's purpose, for it "provides for healthy rambles in the open air and helps to train and to sharpen the power of observation of all its followers."

The book contains admirable illustrations of all the species, in bloom or in fruiting stage, although greatly reduced in size, except some enlarged sections of minute flowers. The keys to families, genera, and species are easy to follow. Besides an

index and an appendix of botanical terms, the book contains a list of grasses, rushes, and flowerless plants found about Kandy.

As a whole, the prevailing species bear a strong alliance, about fifty per cent, to the flora of the Philippines. Being a handy book for explorers, this book should be included among the references for field men or students interested in the study of plants in the vicinity of Kandy.—E. K.

Protein Metabolism in the Plant. By Albert Charles Chibnall. New Haven, Yale University press, 1939. 306 pp., illus. Price, \$4.

This volume is a consolidation of the Silliman lectures which Albert Charles Chibnall, Professor of Biochemistry in the Imperial College of Science and Technology of the University of London, delivered at Yale University. The first four chapters of the book present, in detailed form, the question of protein metabolism in seedlings and a compilation of the scattered contributions of many earlier investigators, such as Pfeffer, Borodin, Gorup-Besanez, and Schulze. Students of biochemistry and plant physiology will find this part of the book certainly interesting and instructive. The rest deals, in a large part, with protein metabolism in leaves and the role of proteins in the respiration of detached leaves. Every scientific library should have a copy of this book.—F. de P.

Respiratory Enzymes. By C. A. Elvehjem and others. Minneapolis, Minnesota, Burgess publishing company, 1939. 236 pp., illus. Price, \$3.25.

As the title suggests, this work is a series of papers prepared by competent biochemists. Each paper deals with one enzyme or group of enzymes, and is a fairly extensive and up-to-date review of literature, valuable for those who desire to get the latest advances on the subject. The topics cover dehydrogenases, oxidases, coenzymes, cytochrome, ascorbic acid, glutathione, and other enzymes having to do with tissue respiration. Special attention is devoted to the mechanism of action in each case, although a special chapter takes up the physicochemical theory of enzyme reactions in general. One chapter deals with oxidation-reduction potentials.—N. C.

Vitality and Energy in Relation to the Constitution. By T. E. Hammond. London, H. K. Lewis & Co., Ltd., 1936. 314 pp., illus. Price, 12s/6.

The book is an interesting discussion on such loose concepts as vitality, stamina, physique, temperament, personality, constitution, life, and other individual attributes. The author attempts to explain some of these from the physiological point

of view, but since our knowledge along these lines is at best rudimentary, his explanations are offered merely as conjectures for others to think of and verify. He suggests, for instance, that somewhere in the basal ganglia is the seat of life or source of energy, the destruction of which would lead to its loss.

There is no doubt that the author is bothered by the frequent complaints of his patients of loss or weakening of vitality, in whom no organic defect could be detected by the most minutious medical and physical examination, but the feeling is there nevertheless and can be observed from their behavior. He looks for an explanation for this condition, but he finds no definite answer. The problem is presented to the reader in a most interesting and stimulating manner.—W. P.

Manual of Toxicology. By Forrest Ramon Davison. With a Foreword by David Marvin. New York, Paul B. Hoeber, Inc., 1939. 241 pp. \$2.50.

This book presents, by careful selection and arrangement, in a simple, clear, concise, practical, and systematic form, the fundamentals and essentials necessary for a text in toxicology in a crowded curriculum, and should prove useful and valuable for practitioners or clinicians interested in brief but reasonably adequate information concerning medical toxicology, the chemical composition, properties, classification and effects of poisons, the symptoms and therapy of poisoning, and the forensic toxicological analysis of fatal poisoning cases. The book consists of well-spaced pages divided into eight chapters, titled as follows: (1) Fundamental principles of toxicology; (2) Classification of poisons, poisoning by acids and alkalis; (3) Metallic poisons; (4) Poisonous gases; (5) Alkaloid poisons; (6) Food poisons, poisoning from snake and reptile bites, poisoning from insect stings; (7) Miscellaneous poisons; and (8) Toxicological analysis.

Each chapter closes with a number of bibliographic references apparently intended to help those who may wish to consult some detailed and general literature. There are numerous references to the books of Blyth, Brundage, Gonzales, Vance and Helpert, Peterson, Haines and Webster, Sollmann, and others. The chapter dealing with the general considerations and technique of toxicological analysis is well discussed and represents an important feature of the book.—G. Q. Q.

The Extra Pharmacopoeia. Martindale. Twenty-first Edition in Two Volumes. Volume II. Published by Direction of the Council of Pharmaceutical Society of Great Britain. London, The Pharmaceutical press, 1938. 1,148 pp. Price, 22s/6.

This volume contains valuable information on the most recent innovations in the fields of medicine, pharmacy, and chemistry.

The analytical addenda gives the analysis of drugs, chemicals, and biological products and the standards required by different pharmacopœias and formularies.

The section on proprietary medicines and the information given under bacteriological and clinical notes should be useful, particularly to the medical practitioner. The former section discloses the composition and indicates the doses of the constituents contained in many patented medicines such as pills, tablets, and powders. The list also includes the uses for which these preparations are advocated, and gives some notes on many diseases and the laboratory methods of their diagnosis. The section on nutrition is particularly interesting. Important investigations and references, especially on vitamins, have been included.

The most recent developments in organic chemistry given in this volume should be of considerable interest to analysis. The newer sensitive organic reagents are given with methods for the detection of many compounds; a scheme for the recognition of organic substances is tabulated and can be confirmed with a chart giving the physical constants and characteristic reactions of many medical compounds; the pH of solutions of some common substances are given, supplemented by new indicators used for volumetric analysis and colorimetric determinations; the use of ultraviolet light and micromethods in analysis is included; and last, but not least in importance, is a much simplified system of chemical nomenclature.

The pharmacist should find this volume a useful reference book. The glossaries of pharmaceutical terms in various languages should be of maximum assistance in dispensing prescriptions. In view of the amount of valuable information provided by this volume, it should be an important asset to any clinic, laboratory, or dispensary.—C. Ll. I.

Epitome of the Pharmacopœia of the United States and National Formulary with Comments. By Robert A. Hatcher and others. Chicago, American medical association, 1938. 244 pp.

This volume is a very good handbook not only for physicians but also for pharmacists. The Pharmacopœia and the National formulary sections contain detailed information which is of interest only to pharmacists; the present book contains the drugs and their preparations, which are included in the two standard

books of drugs, the United States Pharmacopœia, eleventh edition, and the National Formulary, sixth edition. Like these two standard books, the Epitome includes the official titles and their abbreviations; synonyms; brief definitions; concise descriptions of the physical properties, and where necessary, the dosage of the drugs and their preparations. In addition the book gives the actions and uses of the preparations, which are very useful to both physician and pharmacist.

The drugs are arranged alphabetically by Pharmacopœial or National formulary titles and all the preparations of one drug are listed below the name of the drug. This arrangement makes the book very handy.—L. B.

Genetics and the Social Order. By Mark Graubard. New York City, Tomorrow publishers, 1935. 128 pp., illus. Price, cloth, \$0.75; paper, \$0.50.

Mark Graubard, in his work entitled "Genetics and the Social Order," discusses extensively, after reviewing the accepted laws of heredity and the genetic theories, the science of human nature. In lower animals and plants, like in higher animals and man, traits or characteristics are transmitted to the offspring by chromosomes or genes. He dissents with Hitler's idea of exterminating the lower classes, with an object to rear the best in the future. He offers the explanation that normal parents or even highly intelligent ancestors give medium or low-class offspring, and that it would take two thousand years to reduce to one-half the present number of feeble-minded persons. The author adopts a theory, the so-called "theory of variability, which suggests giving everybody a chance to work and determine to what particular line he is best suited. It is through such adaptable environment that social and biologic progress is attained. He cites the Soviet Government as a self-made nation in which such a principle of self-determination is adopted.—E. V. de los S.

City Planning Why and How. By Harold MacLean Lewis. New York-Toronto, Longmans, Green and Co., 1939. 257 pp., illus. Price, \$2.50.

The principles of city planning have not been made sufficiently clear to the average planner in the Philippines. As a result, the average citizen of the country enjoys few of the advantages that the average citizen in planned communities is now enjoying. Mr. Lewis's book meets the need for a treatise on the whys and wherefores of city planning. It is written in so simple and so

interesting a manner that no special training or experience is needed to understand it. The author begins his discussion with planning practices in ancient times and winds it up with a description of a model city of today. In one volume, the present book successfully presents the complete and practical treatment of city planning.

The first part of the book deals principally with the need of city planning in every progressive community. The author touches on the first efforts of many planners who aimed at creating a "city beautiful." Public improvements then were designed to provide pompous civic centers, but little effort was directed towards their practicability and fitness in the general layout. As unplanned cities grow in extent and in population, some of the original improvements will have to be demolished and done over again to conform with modern needs, resulting oftentimes in wasteful expenditures. Mr. Lewis ably illustrates how waste of this nature can be avoided. The author very well presents the healthful effect of planning upon the workers in industrial and business districts, and the convenience that may be enjoyed by the public in general by having adequate parking space. School houses can be placed strategically on a city plan to serve the greatest number of students and provide safer means of access through interior lanes. He also discusses in detail the traffic problem in congested cities and elaborates on the solution of those problems by actual diagrams made from traffic surveys. The proper location of railroads is also discussed in relation to the city layout. Considerable space is given to future expansion and the outward movements of the inhabitants beyond the city limits. Finally, the author analyses the relations of the various public services, such as gas, electricity, telephone, and water systems, to city planing.

The second part of the book deals with the more practical aspects of city planning. The discussion on civic centers is effectively demonstrated by illustrations of actual designs of government centers in the United States. Examples of subdivision plans of residential areas providing a maximum amount of sunlight and air are shown. Separate chapters on transportation and highway plans are given. The highway plans suggested are designed to solve, once and for all, the traffic problem. A well-planned highway system is not merely designed to eliminate traffic congestion; it also provides for co-ordination of through and local streets to insure a smoother and faster traffic flow.

Mr. Lewis, in the concluding chapter, ponders on the future of city planning. He imagines an ideal city which has progressed under the continuous guidance of a planning board. The idealistic picturization of what may be expected from planning our communities seems fantastic, but the imagination need not be extended far to realize that it is within the realm of possibilities. Indeed, the best-planned communities are those that approach most nearly the master plan of a city planner.

—J. P. D.

Laws Relating to Birth Control in the United States and Its Territories.
By Seymour L. Linfield. New York, Birth control clinical research bureau, 1938. 61 pp. Price, \$0.25.

This pamphlet is a compilation of all the provisions of the law relating to birth control in the different states of the Union, including the District of Columbia and the five territories of the United States. It appears in this compilation that the majority of the states, twenty-nine to be exact, have provisions on their statute books relating to birth control. Among the territories, however, only one, Puerto Rico, has a law prohibiting and penalizing birth control.

This pamphlet will be a good reference for students of birth control. The laws of the different states can readily be found, as they are arranged alphabetically under the names of the states.—G. T. L.

Encyclopedia of Knots and Fancy Rope Work. By Raoul Graumont and John Hensel. New York, Cornell Maritime press, Inc., 1939. 615 pp., illus. Price \$10.

Of practical value to our livestock men, farmers, housewives, seamen, and students of household industries, is this book written by Raoul Graumont and John Hensel, who have years of experience at sea. The book deals extensively with the origin and development of practically all kinds of knots and fancy rope work. Of interest to the readers are the notes on the history of knots and rope making appearing on pages 3 to 10. The authors give the history of knots from Neolithic down to Gordian times.

The book contains twelve well-illustrated chapters consisting of 615 pages. Chapter I alone contains 309 different kinds of illustrated knots. The remaining chapters include knots of every description.

For students of handicraft work, the book will always be a valuable companion. The illustrations are so clear and the de-

scriptions so understandable that practically all kinds of knots can be imitated at ease.

The ornamental knots described and illustrated in Chapter VIII will be very helpful to housewives in interior decoration. The beauty produced by 437 different kinds of ornamental knots is indeed wonderful.

The reader will likewise realize the beauty of rope designs in Chapters IX, X, and XI. From fancy knot work and braids, beautiful designs for belts, cord cigarette cases, cravats, slippers, pillow tops, handbags, picture frames, fenders, and many other household effects are nicely made.

Chapter XII illustrates the wonderful process of splicing wire ropes which is equally useful to ships and small boats. Of value to cordage and shipping firms and government textile laboratories is the concluding table appearing on page 576 of the book, dealing with fiber ropes and their characteristics. This table gives the different sizes of commercial ropes with their corresponding breaking strengths and working strains. The table on page 577 on wire ropes will prove useful to dredgers and saw-mills in the Philippines.

The book concludes with a glossary of technical terms which will help the reader understand the different kinds of knots discussed and illustrated. No better illustrated book could have been prepared.—E. E. C.

The Mode in Dress and Home. By Dulcie Godlove Donovan. New Edition. Boston—New York—Chicago—Atlanta—San Francisco—Dallas, Allyn and Bacon, 1939. 460 pp., front., illus. Price, \$1.40.

This book is purposely written for girls to give them instructions on how to be attractive, popular, well-mannered, and helpful at home, in school, and in the community. These desiderata can be achieved, according to the author, by learning how to select, sew, and care for clothing; develop personality; form good habits; and to be a good homemaker as well as a tidy housekeeper.

In a lengthy explanation covering almost one-third of the book, the author, in simple language, with the help of tables, figures, and colored illustrations, gives the practical and yet scientific way of sewing all kinds of garments. Every chapter of this new edition is followed by a few questions which are helpful in readily understanding the subject.—L. Ll. C.

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INDEX

[New names and new combinations are printed in boldface.]

A

Acacia farnesiana (Linn.), 332.
Acanthogobius ommaturus (Rich.), 296.
Achras zapota (Linn.), 332.
Acutipula Alex., 401, 403.
Acythopeus Pasc. 315, 317.
 tristis Pasc., 317.
Acrardisia, 49, 50, 60.
Aegiceraceae, 6.
Aegiceras Gaertn., 5-7, 11, 47.
 corniculata Blco., 47.
 corniculata (Linn.) Blco., 47, 211, 213,
 223, 224, 237, 238.
 majus Gaertn., 47.
Agathis alba (Lam.), 262, 263, 285.
Akosmos Mez, 50, 63, 154.
Alangiaceae, 154.
Alangium faberi var. *perforatum* (Lev.)
 Rehd., 154.
 ALEXANDER, CHARLES P., New or little-
 known *Tipulidæ* from eastern Asia
 (Diptera), XLIII, 375.
Aligui, 441.
Alimañgo, 437.
Alimasag, 437.
Amblychaeturichthys hexanema Blkr., 296.
Amihan, 323.
Amphipterum geluense, 465.
 humatoides Copel., 465.
Anagkong, 323, 332.
Anahaw, 325.
Anantia Koidz., 184.
 marginata Masamune, 188.
 Mezii Masamune, 188.
 stolonifera Koidz., 184, 187, 188.
Anibong, 332.
Antipolo, 332.
Apalochrus cinetoplicatus Pic, 421.
 depressicornis Pic, 421.
Apocynaceae, 46.
Aquifoliaceae, 183, 184.
Ardisia Sw., 3, 4, 6, 7, 12, 48-50, 115, 148,
 154, 184.
 affinis Blm., 195, 197.
 affinis Hemsl., 53, 99, 210, 212, 216, 220,
 224, 231, 236-240.
 arborescens Wall., 50, 57, 80, 222, 238,
 241.
 bicolor Walk., 55, 115, 116, 215, 231.
 Bodinieri Leveille, 105.
 brevicaulis Diels, 53-55, 105, 207, 214,
 215, 220, 226, 227, 231, 232, 235, 237,
 238, 243.

Ardisia—Continued.

brunnescens Walk., 51, 68, 69, 228, 241.
 castaneifolia Lev., 133, 134.
 caudata Hemsl., 52-55, 108, 109, 215,
 221, 222, 224, 233, 238.
 Cavaleriei Lev., 133, 134.
 chinensis Benth., 50, 55, 129, 208-210,
 212, 214, 216, 220, 225, 231, 236,
 239, 241.
 citrifolia Hay., 148.
 colorata Roxb., 62.
 conspersa Walk., 53, 106-108, 221, 235.
 cornudentata Mez, 49, 50, 52, 84, 85,
 151-153, 216, 219-221, 231, 232.
 corymbifera Mez, 53, 55, 100, 108, 222,
 231, 233-235, 238, 241.
 crassinervosa Walk., 52, 86, 89, 209, 311,
 220, 222, 223, 225-227.
 crenata Roxb., 112.
 crenata Sims, 3, 54, 55, 104, 111, 112,
 115, 117, 118, 121, 150-153, 155, 207-
 226, 228-237, 239-243.
 crenulata Lodd., 112.
 crispa A. DC., 115.
 crispa (Thunb.) A. DC., 54, 104, 111,
 112, 115, 118, 119, 148, 150, 152, 212,
 215, 216, 220, 221, 227-232, 236, 237,
 241-243.
 crispa var. A. DC., 110.
 crispa var. *amplifolia* Walk., 54, 121,
 219, 233.
 crispa var. *Dielsii* (Lev.) Walk., 54, 121.
 crispa var. *Dielsii* Walk., 119, 122, 207,
 215, 220, 222, 227, 231, 232, 236-240,
 242.
 crispa var. *Taquetii* Lev., 112.
 crispata Hay., 148.
 densilepidotula Merr., 51, 63, 210, 211,
 213, 219, 223-227, 239.
 depressa C. B. Clarke, 52, 78, 81, 154,
 155, 212, 221, 222, 231, 233-235, 241.
 Dielsii Lev., 121, 122.
 discolor Lev., 154.
 dumetosa Tutch., 90.
 elegans Andr., 55, 110-112, 207, 209-213,
 217, 219, 220, 222-229, 231, 322, 236,
 238, 239, 241, 243.
 elegantissima Lev., 110.
 elliptica Thunb., 5.
 ensifolia Walk., 54, 124, 125, 226.
 esquirolii Lev., 154.
 Faberi Hemsl., 56, 133, 211, 212, 215,
 216, 221, 227, 232, 233, 236, 242, 243.

Ardisia—Continued.

- filiformis* Walk., 54, 126, 212, 224, 231, 236.
floribunda Roem. & Schult., 64.
floribunda Wall., 64.
Fordii Hemsl., 52, 81, 184, 210, 216, 222, 226, 227, 235, 236, 241.
formosana Rolfe, 79.
gigantifolia Stapf, 56, 140, 144, 209–212, 223, 225, 233, 236, 239.
glabra A. DC., 148.
hainanensis Mez, 59, 152.
hanceana Mez, 54, 117, 207, 208, 212, 213, 223, 225, 228, 231, 235.
Henryi Hemsl., 118, 119.
Henryi var. *Dielsii* Walk., 122.
hortorum Maxim., 118, 152, 153.
hortorum var. *brachysepala* Hand.-Mazz., 122.
humilis Vahl, 5, 50, 59, 152, 213, 219, 222, 223, 225–227, 238, 239.
japonica Blm., 3, 56, 135.
japonica (Hornsted) Blm., 134, 148, 149, 207, 208, 211–216, 220, 221, 223, 224, 227–232, 236, 238, 239, 242, 243.
japonica var. *angusta* Makino & Nemoto, 56, 137.
japonica var. *angusta* (Nakai) Makino & Nemoto, 136, 227.
japonica var. *montana* Miq., 148, 149.
japonica var. *montana* (Sieb.) Miq., 136.
Konishii Hay., 110, 112.
kotoensis Hay., 149.
kusukusensis Hay., 149.
Labordei Lev., 112.
lanceolata Roxb., 58.
lentiginosa J. B. Ker, 112.
maclurei Merr., 56, 139, 208, 209, 223, 226, 239.
macrocarpa Wall., 149, 150, 220.
maculosa Mez, 55, 122, 221, 222, 227, 230, 233–235, 241.
mairei Lev., 154.
mamillata Hance, 51, 53, 56, 97, 208–213, 215, 216, 220, 223–225, 231, 232, 235–240, 242.
Meziana Lev., 80.
montana Sieb., 148, 149.
morrisonensis Hay., 84.
mouretii Pitard, 150, 215.
neriifolia Wall., 64.
nervosa Walk., 52, 88, 213, 226, 239.
nigropilosa Pitard, 65.
obtusa Mez, 51, 67, 209, 212, 219, 221, 223–229, 239.
odontophylla Wall., 135, 139, 140, 148, 155.
Oldhami Mez, 82.
olivacea Walk., 54, 127, 128, 224.
ordinata Walk., 56, 137, 138, 139, 148, 226.
pachyphylla Dunn, 67, 68.
patens Mez, 122, 123.
patens var. *tonkinensis* Pitard, 151.

Ardisia—Continued.

- pauciflora* B. Heyne, 73.
penduliflora Mez, 119.
pentagona A. DC., 73.
perforata Lev., 154.
perifera Walk., 51, 70, 71, 213, 226.
primulifolia Gardn. & Champ., 4, 49, 50, 53, 98, 207–210, 212–214, 220, 223–225, 227, 228, 231, 235, 236, 238–240, 242, 243.
pseudovorticillata Merr., 141.
pubivenula Walk., 57, 139, 146, 147, 227.
punctata Lindl., 53, 55, 102–104, 114, 148, 206–214, 216, 218–220, 222, 224–228, 231, 235–238, 240, 242, 243.
punctata var. *latifolia* Walk., 53, 105, 224, 239.
pusilla A. DC., 56, 132, 134, 149, 153, 208, 209, 214–216, 220, 223, 224, 228, 231, 232, 236, 240.
Pyrgus Roem. & Schult., 59.
quinquegona Blm., 51, 52, 73, 74, 78–82, 154, 155, 207–216, 219, 220, 223–226, 228, 229, 231, 232, 235–239, 241–243.
quinquegona var. *hainanensis* Walk., 51, 52, 74, 76, 78, 79, 208, 209, 211, 219, 236.
quinquegona var. *oblonga* Walk., 51, 74, 77, 78, 209, 220, 223, 225, 227, 239.
racemosa Mez, 59.
radicans Hemsl. & Mez, 82.
radicans, 82.
rectangularis Hay., 151.
remotiserrata Hay., 151, 153.
replicata Walk., 57, 144, 145, 148, 222, 235.
reptans Merr., 132.
reptans Mez, 132.
retroflexa Walk., 50, 60, 61, 211, 225.
rhynchotechiodoides (Kränzl.) Hand.-Mazz., 151.
rigida Kurz, 151.
roseiflora Pitard, 55, 101, 237.
salicifolia Walk., 51, 72, 221, 222.
scalarinervis Walk., 56, 140, 222.
shweliensis W. W. Sm., 54, 123, 217.
sieboldii Miq., 52, 79, 80, 212, 214, 216, 218–221, 224, 229, 231, 232, 242, 243.
silvestris Pitard, 56, 142, 143, 223.
simplicicaulis Hay., 152.
sinensis Hort, 152.
solanacea Roxb., 50, 58, 59, 218, 221, 222, 230, 233, 234, 241.
stellata Walk., 51, 65, 66, 222.
stenosepala Hay., 152, 155, 216.
suishaensis Hay., 152, 153.
Tachiba, 153.
tachibana Makino, 153.
Taquetii Lev., 112.
tenera Mez, 52, 80, 211, 221, 222, 225.
thyrsiflora D. Don, 64.
tinifolia Sw., 49.
trichnarpa Merr., 90.
triflora Hemsl., 50, 55, 129–131, 214, 216, 227.

Ardisia—Continued.

- tuiflora* Hemsl., 130.
undulata C. B. Clarke, 106, 108.
undulata Mez, 108.
velutina Pitard, 155.
vestita Wall., 90, 91.
villosa Mez, 132.
villosa Roxb., 53, 90, 91, 93, 96, 132, 211, 212, 221-223, 225, 226, 231, 236, 237, 239, 241.
villosa var. *ambovestita* Walk., 53, 91, 208, 209, 213, 239.
villosa var. *latifolia* Walk., 53, 92, 93, 227.
villosa (Thunb.) Mez var. *liukiensis* (Nakai) Makino & Nemoto, 153.
villosa var. *oblanceolata* Walk., 53, 93, 94, 213, 223, 225, 226.
villosoides Walk., 53, 93, 95, 213, 223.
violacea Susuki-Tokyo, 153.
virens Kurz, 52, 55, 82, 84, 207, 216, 217, 219-222, 224, 228, 229, 232-235, 241, 242.
yunnanensis Mez, 51, 64, 155, 222, 232, 240, 241.
sp., 210, 211, 223, 227, 238.
Ardisiaceae, 2.
Ardisiaceae, 7, 11.
Aroma, 332.
ARRIOLA, FELIX J., A preliminary study of the life history of *Scylla serrata* (Forskål), 437.
Arthropteris Sm., 356.
articulata, 356.
dolichopoda v. A. v. R., 356.
kingii Copel., 356.
orientalis, 356.
Artocarpus *blancoi* (Elm.) Merr., 332.
Astelobia Edw., 416.
Atherina, 339.
doudecimialis (Cuv. & Val.), 337, 423.
Athruphium Lour., 194.
lineare Lour., 194, 200.
Austrolimnobia Alex., 416.
Auxis thazard (Lacép.), 423.

B

- Baeobotrys J. & G. Forst., 12, 15.
argentea Wall., 14, 15.
indica Roxb., 40.
memoralis J. & G. Forst., 12.
ramentacea Roxb., 33.
(Maesa) *argentea* Wall., 15.
Bahan, 327.
Bait, catching of live, 337.
Bakaw, 326.
Banata, 323, 327.
Baños, 437.
Barinae, 313.
Baring, 327.
Baringbing, 332.

- Bathygobius Blkr., 301, 305.
blancoi Roxas and Ablan, 306.
bravoii Herre, 306.
cocosensis, 305.
lae Roxas and Ablan, 306.
mearnsi (Evermann and Scale), 306.
Bayugin, 440.
Binonga, 332.
Bintol, 437.
Bitter melon, 318.
Bladhia Hornsted, 3, 4, 48-50, 55, 100, 153.
Thunb., 48.
(Thunb.) Mez, 129.
chinensis Nakai, 129.
citrifolia Nakai, 148.
cornudentata Nakai, 84.
crispa Thunb., 3, 112, 115, 118, 150, 153.
crispa var. *Taquetii* Lev., 151.
crispa var. *Taquetii* Nakai, 112.
elegans Koidz, 110.
glabra Thunb., 148.
japonica Hornsted, 48, 134, 135.
japonica Thunb., 3.
japonica var. *angusta* Nakai, 136.
kotoensis Nakai, 149.
lentiginosa Nakai, 112.
lentiginosa var. *Taquetii* Nakai, 112.
montana Nakai, 149.
morrisonensis Nakai, 84.
punctata Nakai, 102.
quinquegona Nakai, 73.
Sieboldii Nakai, 79.
villosa Thunb., 132, 153.
villosa var. *liukiensis* Nakai, 153.
violacea Susuki-Tokyo, 153.
[Bladhia] *japonica*, 149.
Bobua glauca Nakai, 193.
Bolinao, 342.
Bonitos, 423.
Books, 359, 471.
Boroda Herre, 301, 302.
albo-oculata Herre, 303.
expatria Herre, 303.
francoi Roxas and Ablan, 303.
Bostrichthys sinensis (Lacép.), 293.
Brithura Edw., 403.
Bunuan, 325, 328.
Buxaceae, 194.

C

- Cabiao, 327.
Calaycayan, 325.
Calispermum Lour., 155.
scandens Lour., 155, 163.
Callinectus sapidus, 439.
Camalig, 325.
Canay, 327.
Castanopsis, 354, 356.
Catechu, 321.
Caudto, 322.
Cawa, 329.
Ceiba pentandra (Linn.), 332.
Celastraceae, 184, 194.

- Celastrus Cavalieri* Lev., 190.
 gemmata Loesn., 184.
 Seguini Lev., 191.
 stylosa Wall., 190.
Cephalomanes oblongifolium Presl, 467.
Chæturichthys stigmatius Rich., 296.
Chanidae, 437.
Chanos chanos Forsk., 437.
Chasmichthys petschiliensis (Rendahl), 296.
Chico, 332.
Chinchorro, 339.
Chinese gobies, 293.
Chloranthaceæ, 154.
Chloranthus brachystachyus Blm., 154.
 glaber Makino, 148.
Choripetalum A. DC., 155.
 aurantiacum A. DC., 155.
 Benthamii Hance, 181.
 obovatum Benth., 181.
Chrysophyllum Augustini Nakai, 44.
Cnemocosis hilgendorfi End., 381.
Cocos nucifera (Linn.), 332.
Coleoptera, 313.
Coléoptères malacodermes nouveaux, 421.
Coloban, 329.
Conandron rhynchotechioides KränzL., 151.
Copal, Manila, analysis and composition of,
 259; refining of, 285.
COPELAND, EDWIN BINGHAM, *Olean-*
dris ferns (Davalliaceæ) of New
 Guinea, 345; Notes on *Hymenophylla-*
 ceæ, 457.
Cornaceæ, 154.
Cornus oblonga Wall., 154.
Crepidomanes bilabiatum, 466.
 brevipes (Presl) Copel., 466, 467.
 rupicolium (Racib.) Copel., 466.
 venulosum, 467.
Crispardiisia Mez, 4, 49, 50, 52, 56, 65, 82,
 100, 127, 149, 150, 155.
Crustacea, Philippine, 307.
Ctenacroscelis broddignagius (Westw.), 383-
 386.
 clavipes Edw., 382.
 goliath Alex., 384.
 herculeanus Alex., 383, 384.
 mikado (Westw.), 382.
Ctenogobius chusanensis Herre, 295.
 lini Herre, 296.
Ctenophora Meig., 382.
 nohirai Alex., 381.
 nohirai Mats., 381.
Cubcub, 322.
Cubcubillo, 325.
Cubcubillo-an, 327.
Cucurbit-boring barid, Philippine, 313.
Curculionidæ, 313.
Cylindrotominae, 407.
Cynethia Pasc., 315.

D

- Dala*, 327.
Dalinsi, 332.

- Dartus* Lour., 12.
 perlarius Lour., 12, 24, 26.
Davallia Sm., 348, 355.
 corniculata, 355.
 denticulata (Burm.) Mett., 355.
 divaricata Blm., 355.
 Farbesii Carruthers, 348.
 epiphylla (Forst.) Spr., 355.
 papuana Copel., 355.
 pullei Ros., 355.
 pyxidata Cav., 355, 356.
 solida (Forst.) Sw., 355, 356.
 tenuisecta Copel., 355.
 trichomanoides Blm., 355, 356.
 (Humata) *bipinnatifida* Baker, 353.
Davalliaceæ, 345.
Davallodes Copel., 347.
 dolichosorum Copel., 347, 348.
 novoguineense (Ros.) Copel., 347, 348.
Dictenidia Brullé, 382.
 fasciata Coq., 381.
 glabrata Alex., 380, 381.
 luteicostalis, 381.
 luteicostalis longisector Alex., 381.
 pictipennis fasciata Coq., 381.
 stalactitica Alex., 379, 381.
Didymoglossum anomalum, 467.
Diptera, 375.
Distylium strictum Hemsl., 193, 207.
Dolichopeza (Nesopeza) *albitibia* (Alex.),
 407.
 (Nesopeza) *geniculata* (Alex.), 407.
 (Nesopeza) *tarsalis* (Alex.), 407.
 (Oropeza) *candidipes* (Alex.), 406.
 (Oropeza) *saitamensis* Alex., 407.
 (Oropeza) *satsuma* (Alex.), 407.
DOMANTAY, JOSE S., The catching of live
 bait for tuna in Mindanao, 337; tuna
 fishing in southern Mindanao, 423.
Doraena Thunb., 12.
 japonica Thunb., 12, 19.
Dulong-dulong, 342.
Dungon, 332.
Dussumieria hasseltii (Blkr.), 337, 428.

E

- Elagatis bipinnulatus* (Quoy and Gaim.),
 423, 425, 426.
Eleotridæ, 293, 301.
Embelia Burm. f., 4-7, 12, 155, 156, 171,
 182-184.
Embelia Clarke, 158.
 aberrans Walk., 157, 169, 170, 235.
 Blinii Lev., 178.
 Bodinieri Lev., 167.
 Cavaleriei Lev., 183.
 Dielsii Lev., 178.
 esquirolii Lev., 183.
 floribunda Wall., 156, 160, 217, 218,
 230, 233, 234.
 Fordii Mez, 81, 184.
 Gamblei Kurz, 156, 162, 184, 218, 230,
 233.

Embelia—Continued.

- hainanensis Merr., 163.
 henryi Walk., 157, 175, 221.
 kaopoensis Lev., 178.
 laeta (Linn.) Mez., 157, 180, 181, 207-214, 220, 223-226, 229, 235-239, 241-243.
 laeta Mez, 183.
 lenticellata Hay., 157, 168, 217, 243.
 longifolia (Benth.) Hemsl., 157, 178, 183, 208-211, 214, 216, 220, 223, 225, 227, 232, 236, 238-240, 242.
 longifolia Hemsl., 179.
 myrtifolia Hemsl. & Mez, 171.
 nagushia D. Don var. subcoriacea C. B. Clarke, 180.
 oblongifolia Hemsl., 157, 165, 167, 183, 208-210, 212-215, 221-227, 229-242.
 obovata Hemsl., 181.
 parviflora Wall., 4, 157, 171, 208-210, 212, 214, 220-222, 224-227, 229-231, 233-236, 239-242.
 pauciflora Diels, 157, 176, 177, 207, 237, 238.
 pauciflora var. Blinii (Lev.) Walk., 157, 177, 178, 207, 211.
 pauciflora var. Blinii Walk., 178.
 penduliramula Hay., 182, 183.
 polypodioides Hemsl., 4, 157, 173, 221, 232, 233.
 procumbens Hemsl., 157, 174, 215, 221, 238.
 prunifolia Mez, 165.
 ribes Burm. f., 155, 156, 159, 207-214, 217-229, 231, 233-239, 241-243.
 rubrinervis Lev., 184.
 rubro-violacea Lev., 184.
 rudis Hand.-Mazz., 156, 164, 207-214, 216, 219, 220, 223-225, 228, 231, 235-237, 239, 240, 243.
 saxatilis Hemsl., 174.
 scandens (Lour.) Mez, 156, 163, 208, 212, 213, 225, 226, 236, 238.
 scandens Mez, 163.
 Schlechteri Lev., 176.
 sessiliflora Kurz, 4, 156, 158, 217, 222, 230, 234, 238, 240, 241.
 subcoriacea (C. B. Clarke) Mez, 157, 180, 183, 217, 218, 221, 224, 227, 232-234, 238, 240, 241.
 subcoriacea Mez, 180.
 undulata (Wall.) Mez, 183.
 undulata Mez, 183.
 valbrayi Lev., 184.
 vanioti Lev., 184.
 vestita Roxb., 157, 165, 166, 217, 218, 221, 230, 232, 238.
 viridiflora (A. DC.) Scheff., 183.
 Embeliopsis Mez, 156, 160.
 Entada phaseoloides (Linn.), 332.
 Ericaceae, 184.
 Eriopterini, 415.
 Euembelia, 156.
 Eugenia cumini (Linn.), 332.

- Eurya Cavaleriei Lev., 46.
 nitida Korth., 206.
 Euthynnus yaito (Kishinouye), 423.

F

- Fanna tadsii banna, 3.
 Ferns, oleandrid, of New Guinea, 345.
 Fishes, Philippine gobioid, 301.
 Fishing gear, preservation of, 321.
 Formotipula Mats., 406.

G

- Gapas, 332.
 Gaultheria yunnanensis (Franch.) Rehd., 184.
 Gaway-gaway, 332.
 Gobies, Chinese, 293.
 Gobiidae, 301.
 Gobioidae, 297.
 Gogo, 332.
 Gono, 342.
 Gonocormus, 464, 465.
 alagense (Chr.), 467.
 novoguineensis (Brause) Copel., 467.

H

- Habagat, 322.
 Hagnaya, 325.
 Hamamelidaceae, 193, 207.
 Heritiera littoralis Dryand., 332.
 HERRE, ALBERT W. C. T., Notes on fishes in the Zoological Museum of Stanford University, VIII. A new genus and two new species of Chinese gobies with remarks on some other species, 293.
 Heterembelia, 156, 161.
 Hexatoma regina, 415.
 (Eriocera) pyrrhophyga Alex., 414.
 (Eriocera) regina Alex., 414.
 (Eriocera) regina kiuhuana Alex., 414.
 Hexatomini, 412.
 Humata Cav., 348, 349, 353.
 alpina (Blm.) Moore, 352, 353.
 alpina var. edentula Ros., 352.
 Archboldii Copel., 349, 350, 353.
 Banksii, 348.
 Brassii Copel., 349, 351.
 crassifrons v. A. v. R., 349, 351.
 cromwelliana Ros., 350, 353.
 deltoidea Copel., 349, 352.
 dimorpha Copel., 349, 351.
 gaimardiana (Gaud.) J. Sm., 348.
 heterophylla (Sm.) Desv., 349, 350.
 introrsa Chr., 350, 354.
 kinabaluensis Copel., 349, 352.
 Ledermanni Brause, 351.
 mecodioides Copel., 350, 354.
 neoguineensis C. Chr., 350, 353.
 parallela (Wall.) Brack., 348-350.
 parvula (Wall.) Mett., 349, 351.
 pectinata, 348.
 perpusilla v. A. v. R., 351.

Humata—Continued.

- pusilla Chr., 351.
 - pusilla (Mett.) Carr., 349, 351, 352.
 - repens (Linn.) Diels, 349, 352, 365.
 - repens var. minor Ros., 352.
 - Schlechteri Brause, 351.
 - sessilifolia Mett., 349-351.
 - similis Copel., 350-353, 354.
 - subtilis v. A. v. R., 351.
 - tenuis Copel., 349, 353.
 - tenuivenia Copel., 349, 350.
 - vestita (Blm.) Moore, 350, 353, 354.
 - wernerii Copel., 350, 353.
- Hymenophyllaceae, 457.
- Hymenophyllum, 458.
- atrovirens Col., 457.
 - bismarckianum Chr., 459.
 - Blumeianum Spr. var. novoguineensis Ros., 458.
 - Brassii C. Chr., 463.
 - brevifrons v. A. v. R., 461.
 - circinnatum, 462.
 - ellipticosorum v. A. v. R., 462.
 - firmum v. A. v. R., 461.
 - Foersteri Ros., 463.
 - meyenianum Copel., 460.
 - minimum A. Rich., 457.
 - polyanthos Copel., 458.
 - rubellum, 461.
 - serrulatum var. cristulatum cum fo. minor Ros., 460.
- Hypseleotris Gill, 301.
- pangel Herre, 302.
- quisumbingii Roxas and Ablan, 301.

I

- Ilex, 46.
- metabaptista var. myrsinoides (Lev.) Rehd., 46, 183, 194.
 - purpurea Hassk., 184.

J

- Jamma tadsii banna, 3.

K

- Kalamarina, 332.
- Kalong, 440.
- Kamanchile, 332.
- Katsuwonius pelamis (Linn.), 423.
- Kayagkag, 327.

L

- Lagenaria siceraria (Mol.) Standley, 318.
- Lampara, 325.
- Laurus glauca Thunb., 193.
- Lawag, 327, 328, 340.
- Laya, 327.
- Leucaena glauca (Linn.), 332.
- Leucostegia Presl, 348.
- laxascaphides (Baker) C. Chr., 348.
 - pallida (Mett.) Copel., 348.
 - subdigitata (Brause) C. Chr., 348.
- Life history of Scylla serrata (Forskål), 437.

Ligcop, 327.

- Limnophila fokiensis Alex., 412, 413.
- (Adelphomyia) pilifer Alex., 414.
 - (Adelphomyia) reductana Alex., 413, 414.
- Limonia (Limonia) albitarsis Alex., 410.
- (Limonia) longivena (Edw.), 410.
 - (Limonia) palniensis Alex., 410.
 - (Limonia) whitae Alex., 409, 410.
- Limoniinae, 409.
- Limoniini, 409.
- Live bait, catching of, 337.
- Lobi, 332.
- Lombol, 332.
- Longurio pulverosa (Mats.), 382.
- Luffa sp., 318.
- Lunatipula Edw., 403.
- Lysimachia lancifolia Craib, 154.
- Lyteriides, 315.

M

- Macaranga tanarius (Linn.), 332.
- Macroglena, 461, 466, 467.
- schlechteri (Brause) Copel., 467.
- Madarides, 315.
- Maesa Forsk., 5-7, 11-13, 15, 36, 43-46.
- acuminatissima Merr., 14, 32, 208, 209, 211, 225-227, 229, 236, 239.
 - argentea A. DC., 15.
 - argentea (Wall.) A. DC., 13, 14, 217, 218, 220, 230, 233, 234, 238.
 - argentea Wall., 15.
 - argentea var. kwangsiensis Hand.-Mazz., 43.
 - augustini (Nakai) Tuyama, 44.
 - aurea Lev., 45.
 - Balansae Mez, 14, 39, 213, 224-228, 236, 239.
 - Blinii Lev., 45.
 - bodinieri Lev. and Blin., 46.
 - castaneifolia Mez, 29.
 - Cavaleriei Lev., 19.
 - chisa D. Don, 46.
 - consanguinea Merr., 14, 42, 209, 211, 226, 239.
 - coriacea Champ., 19.
 - depauperata Diels, 46.
 - Doraena Blm., 19.
 - Dunniana Lev., 19.
 - elongata Mez, 29.
 - Esquirolii Lev., 19.
 - formosana Mez, 35, 36, 45.
 - Henryi Hu, 29.
 - hirsuta Walk., 24.
 - hupehensis Rehd., 14, 22, 37, 211, 215, 216, 221, 227, 228, 242.
 - indica A. DC., 40.
 - indica (Roxb.) A. DC., 14, 34, 36, 40, 44, 47, 220, 221, 232-235, 238.
 - indica (Roxb.) Wall., 40, 41.
 - indica var. retusa Hand.-Mazz., 32.
 - insignis Chun, 13, 24, 25, 231-233, 237-240.
 - japonica Mor., 19.

Maesa—Continued.

- japonica (Thunb.) Mor., 13, 19, 22, 23, 35, 45, 46, 194, 207-218, 215, 216, 219-233, 235-243.
 japonica var. elongata Mez, 19, 22, 37, 45.
 japonica var. latifolia Miq., 44.
 Labordei Lev., 19.
 lanceolata Forsk., 12.
 lanceolata *a* paniculata var. pyrifolia (Miq.) Kze., 44.
 laxiflora Pitard, 14, 42, 220, 223, 226.
 macilenta Walk., 13, 22, 23, 222.
 Martini Lev., 35.
 membranacea A. DC., 14, 38, 43, 213, 223, 226, 227, 239.
 mollis A. DC., 45.
 mollis Decne., 45.
 montana A. DC., 13, 14, 28, 30, 34, 36, 40, 44, 46, 208, 215-217, 220-222, 227, 230-235, 238, 240-243.
 montana var. elongata A. DC., 29.
 myrsinoides Lev., 46.
 parvifolia A. DC., 13, 28, 226.
 perlarius (Lour.) Merr., 13, 24, 28, 36, 207-214, 218, 219, 221-232, 235-239, 241-243.
 perlarius Merr., 26.
 permollis Kurz, 13, 16, 209, 218, 221, 222, 230, 235, 241.
 permollis var. effusa Walk., 13, 17, 217, 218.
 ramentacea A. DC., 33.
 ramentacea (Roxb.) A. DC., 14, 33, 212, 221, 222, 231, 233, 235, 236, 238, 241.
 ramentacea (Roxb.) Wall., 33.
 randaiensis Hay., 45.
 rugosa C. B. Clarke, 14, 30, 31, 218, 220, 240.
 rugosa var. Griffithii C. B. Clarke, 30, 32.
 salicifolia Walk., 13, 17, 18, 22, 23, 207, 208, 210, 222, 226, 228.
 scandens Lev., 46.
 sinensis A. DC., 26, 27.
 singuliflora Lev., 46.
 taiheizanensis Sasaki, 45.
 tenera Mez, 14, 26, 34, 36, 37, 44, 45, 207, 209, 211, 212, 214-217, 219, 223, 224, 226-229, 231, 232, 236-239, 241-243.
 Wilsonii Rehd., 37.
 sp., 217, 218, 222, 227, 234.
- Maesoidae, 7.
 Magnoliaceae, 184.
 Malawa, 327.
 Manila copal, analysis and composition of, 259; refining of, 285.
 Manilabaris Zimmerman, 314, 315.
 cucurbitae, 315, 316, 317.
 Mapo Smitt, 305.
 Matang Baca, 342.
- Mecodium Archboldii Copel., 458.
 atrovirens (Col.) Copel., 457.
 australe (Willd.), 457.
 badium (H. & G.) Copel., 460.
 bismarckianum (Chr.) Copel., 459.
 involucratum, 459.
 longifolium, 459.
 mnioides (Baker) Copel., 460.
 novoguineense (Ros.) Copel., 458.
 ooides (F. V. M. & Baker) Copel., 459, 460.
 polyanthos, 458.
 thuidium, 459.
- Megalaspis cordyla (Linn.), 337, 339, 428.
 Melengkiet, 264.
 Melon, bitter, 318.
 Meringium, 458, 463, 464.
 acanthoides, 459.
 archboldii Copel., 462.
 bartlettii Copel., 464.
 Brassii (C. Chr.) Copel., 457, 463, 464.
 denticulatum, 459.
 firmum (v. A. v. R.), 463.
 foersteri (Ros.) Copel., 463.
 gorgoneum Copel., 460.
 herterianum, 462.
 holochilum, 462, 463, 465.
 latifolium Copel., 461.
 melanosorum Copel., 462.
 meyenianum, 460, 461.
 minimum (A. Rich.) Copel., 457.
 novoguineense, 459.
 praetervisum (Chr.), 465.
 rubellum (Ros.) Copel., 460.
- Micrembelia Mez, 157, 169, 171.
 Micropercopis, 293.
 Microtrichomanes armstrongii (Baker) Copel., 457.
 dichotomum (Kze.) Copel., 457.
 digitatum, 457.
- Microtropis fokiensis Dunn, 194.
 Molophilus gracilis, 416.
 (Molophilus) kiushiuensis Alex., 416, 417.
- Momordica charantia Linn., 318.
 Mugilogobius Smitt, 301, 307.
 dispar Peters, 308.
 luzonensis Roxas and Ablan, 307.
- Myctides Pasc., 315.
 Myriodon, 464.
 odontophyllum, 463.
- Myrsinaceae, eastern Asiatic, 1-8, 10, 11, 187, 193, 194, 207, 243, 249.
 Myrsine Linn., 4-7, 11, 12, 184, 185, 193, 195.
 affinis A. DC., 195.
 affinis (Blm.) A. DC., 195.
 africana Linn., 4, 184, 185, 189, 192, 207, 211, 212, 215-217, 219-221, 227-233, 237, 238, 240, 242, 243.
 africana var. bifaria Franch., 186.
 ardisioides Hook and Arn., 193.
 bifaria Wall., 186.
 buxifolia Hance, 193, 207.

Myrsine—Continued.

- capitellata Wall., 202, 205.
 Cavaleriei Lev., 193, 194.
 Chaffanjonii Lev., 194.
 Chevalieri Lev., 194.
 elliptica Walk., 185, 189, 192, 239, 240.
 Esquirolii Lev., 19, 194.
 feddei Lev., 194.
 laeta A. DC., 181.
 linearis Poir., 200.
 marginata Mez, 184, 185, 187, 188, 190,
 192, 207, 209, 213, 215, 216, 219, 220,
 227, 233, 235, 238, 239, 242.
 microphylla Hay., 186.
 nerifolia Mez, 202.
 Playfairii Hemsl., 200.
 semiserrata Wall., 6, 185, 188-190, 202,
 207, 211, 212, 215-218, 220-222, 225-
 227, 230-234, 236, 238, 240-243.
 seguini Lev., 202.
 thunbergii Tanaka, 193.
 undulata Wall., 183.
 vacciniifolia Hay., 186.
 Myrsineaceæ, 2.
 Myrsinæ, 2, 7, 11.
 Myrsinoideæ, 7.

N

- Neothunnus itosibi Jordan and Evermann,
 423.
 macropterus (Schlegel), 423.
 Nephrotoma aurantiocincta Alex., 405, 406.
 grahamiana Alex., 403, 405.
 impigra Alex., 403.
 sinensis (Edw.), 403.
 takeuchii Alex., 406.
 Neptunus pelagicus Linn., 437.
 Nesopeza albitibia Alex., 407.
 paniculata Alex., 407.
 tarsalis Alex., 407.
 Nudagobioides, 301.
 monseratti Roxas and Ablan, 309.
 nankaii Shaw, 297, 310.
 Taen-Hwang-Shaw, 309.

O

- Odontamblyopus rubicundus (Buch.-Ham.),
 298.
 Odontobutis Davidi (Sauv. & Thiersant),
 295.
 obscurus (Schlegel), 295.
 Oleandra Cav., 345.
 Archboldii Copel., 345, 346.
 colubrina (Blco.) Copel., 346.
 colubrina var. membranacea, 346.
 crassipes Copel., 345, 347.
 Cumingii, 347.
 cuspidata Baker, 346.
 dimorpha Copel., 347.
 gracilis Copel., 345, 347.
 hirtella Mid., 346.
 hirtella (Mq.) Kze., 346.

Oleandra—Continued.

- mollis Presl, 346.
 neriformis Cav., 345, 346.
 neriformis var. mollis (Pr.), 346.
 pistillaris (Sw.) C. Chr., 346.
 Sibbaldii Grev., 345-347.
 wernerii Ros., 345, 347.
 Whitmei, 347.
 Orchidophilus Buch., 315.
 Oreomyza Fokorny, 397.
 Oropeza candidipes Alex., 406.
 satsuma Alex., 407.

P

- Pachyrrhina sinensis Edw., 403.
 Pahubas, 323.
 Palma brava, 325.
 Paloa Herre, 301, 304.
 polylepis Herre, 305.
 villadolidi Roxas and Ablan, 304.
 Panit, 423.
 Paños, 325.
 Pante, 327, 437.
 Panukot, 437.
 Papag, 327.
 Parathunnus sibi (Schlegel), 423.
 Patola, 318.
 Paugmad, 323.
 Pedicia Latr., 375, 411.
 (Pedicia) gifuensis Kariya, 411.
 (Pedicia) subfalcata Alex., 410, 411.
 (Tricypnophora) elegans invaripes Alex.,
 412.
 Pediciini, 410.
 Peltophorum inerme (Roxb.) Llanos, 332.
 Periophthalmidæ, 297.
 Periophthalmus barbarus (Linn.), 297.
 Phasianus, 393.
 PIC, M., Coléoptères malacodermes nouve-
 aux, 421.
 Pieris oligodonta Lev., 19.
 Pithecolobium dulce (Roxb.), 332.
 Pleuromances, 466.
 acutum Presl, 466.
 pallidum (Blm.) Presl, 466.
 retusum Copel., 466.
 Plocimas magnificus Alex., 381.
 magnificus Enderlein, 381.
 Polemiosilis boettcheri Pic, 421.
 forticornis Pic, 421.
 latiorithorax Pic, 421.
 proximus Pic, 421.
 Polygala venenosa Juss., 325.
 Popa, 327.
 Fortunidæ, 437.
 Primulacæ, 7, 154.
 Prionolabis O. S., 413.
 Pselliophora O. S., 382.
 scalator Alex., 376, 377.
 scurra Alex., 376.
 Pyrgus racemosa Lour., 59.

Q

Quercus phillyreoides A. Gray, 46.

R

- Rapanea* Aubl., 4-7, 12, 185, 187, 194, 195, 206.
affinis (A. DC.) Mez, 196.
affinis (Blm.) Mez, 195, 211, 213, 216, 225, 227.
affinis Mez, 195.
aurea Lev., 206.
buxifolia (Hance) Mez, 193, 207.
Faberi Mez, 195, 197, 215, 218, 221, 223, 225, 229, 233, 234, 237, 239.
guianensis Aubl., 194.
kwangsiensis Walk., 195, 198, 199, 212, 220, 224, 232.
linearis (Lour.) S. Moore, 195, 200, 202, 205, 213, 214, 219, 220, 223-227, 229, 237-239.
linearis S. Moore, 200.
Maximowiczii Koidz., 195, 201, 206, 242, 243.
neriifolia (Sieb. & Zucc.) Mez, 195, 198, 202, 206-209, 211-216, 219-227, 229, 231-233, 235-239, 242, 243.
neriifolia Mez, 193, 202.
neriifolia var. *yunnanensis* (Mez) Walk., 195, 205, 212, 217, 218, 220, 222, 227, 230, 232-236, 238, 240, 241.
nerifolia var. *yunnanensis* Walk., 205.
okabeana Tuyama, 206.
playfairii (Hemsl.) Mez, 205.
playfairii Mez, 200.
stolonifera Nakai, 188.
Walkeriana Hand.-Mazz., 202.
yunnanensis Mez, 206.
RASALAN, SANTOS, B., Preservation of fishing gear in Samar Province, Philippines, 321.
Rastrelliger Chrysozonus (Rupp.), 337, 339, 428.
Rhamnaceae, 45, 184.
Rhamnella rubrinervis (Lev.) Rehd., 184.
Rhamnus Blinii (Lev.) Rehd., 45.
crenatus, 198.
myrtillus, 86.
Rhizophora, 47.
corniculata Linn., 47.
spp. 323, 326.
Ribesiodes Kze., 155.
Linn., 155.
floribundum Kze., 160.
Gamblei Kze., 162.
longifolium Kze., 179.
oblongifolium Kze., 167.
obovatum Kze., 181.
parviflorum Kze., 171.
ribes Kze., 155, 159.
sessiliflorum Kze., 158.
vestitum Kze., 165.

ROXAS, HILARIO A., and *GUILLERMO L. ABLAN*, New Philippine gobioid fishes, 301.

S

- Sabia* sp., 193.
Sabiaceae, 193.
Sakay, 437.
Salibut, 327.
Samara Linn., 155.
laeta Linn., 155, 181.
longifolia Benth., 178.
obovata Benth., 181.
Sandoricum koetjape (Burm. f.) Merr., 332.
Sangab, 339, 428.
Santol, 332.
Sapiao, 327.
Sapiaoan, 428.
Sarcococca Hookeriana var. *humilis* Rehd., 194.
Sardinella, 428.
fimbriata (Cuv. & Val.), 337, 339, 428.
leiogaster (Cuv.), 337, 339, 428.
melanura (Cuv. & Val.), 337, 339, 428.
perforata (Cantor), 337, 339, 428.
Schizandra propinqua Hook. f. and Thoms. var. *sinensis* Oliv., 184.
Scomberoides tolo (Cuv. & Val.), 337, 339, 428.
Scutengraulis mystax (Bl.) 337, 339.
Scyphularia Fee, 356.
dorsalis Copel., 356.
pentaphylla (Blm.) Fee, 356.
sinusora Copel., 356.
Schummelia Edw., 396, 403.
Scylla serrata (Forsk.), 437; life history of, 437.
Selar crumenophthalmus (Bl.), 337, 339.
Selenodesmium, 467.
obscurum (Blm.) Copel., 467.
Sesbania grandiflora (Linn.), 332.
Sigmatomera (Austrolimnobia) *rarissima* Alex., 415, 416.
Siguin, 428.
Silverside, 428.
saccharæ Herre, 293.
Sinoblan, 329.
Skipjack, 423.
Sodsod, 327.
Solambao, 327.
Sphyaena obtusata (Cuv. & Val.) 337, 339, 428.
Squash, white, 312.
Stolephorus indicus (van Hasselt), 337, 339, 428.
Striped tuna, 423.
Symplocaceae, 45.
Symplocos Bodinieri Brand, 45.
laurina (Retz.) Wall., 46.
Synechogobius hasta (Schlegel), 296.

T

- Tabigi, 323, 326.
 Tabigi-an, 326.
 Talisai, 332.
 Tamban, 342.
 Tamanka Herre, 301, 308.
 arguellesi Roxas and Ablan, 308, 310.
 umbra Herre, 309.
 TANCHICO, S. S., and AUGUSTUS P. WEST, Analysis and composition of Manila copal, 259; refining of Manila copal, 285.
 Tanyptera Latr., 382.
 antica, 379.
 antica anticoides Alex., 379.
 cognata Alex., 379.
 subcognata Alex., 377.
 Terminalia catappa (Linn.), 332.
 pelucida Presl, 332.
 Theaceæ, 206.
 Theophrastaceæ, 7.
 Theophrastus, 7.
 Thunnidæ, 423.
 Thunnus, 423.
 Tinus Burm., 48.
 (Burm.) Mez, 49, 50, 57.
 affinis Kze., 99.
 caudata Kze., 109.
 crispa Kze., 112.
 crispa var. macrocarpa Kze., 149.
 depressa Kze., 78.
 Faberii Kze., 133.
 Henryi Kze., 119.
 humilis Kze., 59.
 japonica Kze., 135.
 mamillata Kze., 97.
 montana Kze., 149.
 primulifolia Kze., 98.
 punctata Kze., 102.
 racemosa Kze., 59.
 Sieboldii Kze., 79.
 triflora Kze., 130.
 virens Kze., 82.
 Tipula, 406.
 filicornis, 400, 401.
 mikado Westw., 382.
 mutila, 397.
 parvaurecula Alex., 400, 401.
 reservata Alex., 401.
 (Acutipula) biastata Alex., 390.
 (Acutipula) biramosa Alex., 390, 491.
 (Acutipula) luteinotalis Alex., 388, 390, 391.
 (Acutipula) platycantha Alex., 388.
 (Acutipula) stenoterga Alex., 391, 393.
 (Formotipula) spoliatrix Alex., 387, 388.
 (Lunatipula) furiosa Alex., 398, 440.
 (Nippotipula) klapperichi Alex., 386, 387.
 (Oreomyza) kuatunensis Alex., 397.
 (Oreomyza) liui Alex., 395.
 (Oreomyza) savionis Alex., 398.

Tipula—Continued.

- (Vestiplex) bifida Alex., 394.
 (Vestiplex) cremeri Alex., 393.
 Tipulidæ, 306.
 from eastern Asia, 375.
 Tipulinæ, 376.
 Togotipula pulverosa Mats., 382.
 Trachelospermum axillare Hook. f., 46.
 Trapal, 331.
 Trema orientalis (Linn.), 323, 332.
 Trichomanes angustatum Carm., 466.
 Armstrongii Baker, 457.
 latifrons v. d. B., 465.
 novo-guineense Brause, 467.
 savaiense Lauterbach, 466.
 tenerum Spr., 466.
 Tridentiger bifasciatus Steind., 297.
 trigonocephalus (Gill), 297.
 Triogma Schiner, 408.
 kuwanai (Alex.), 408.
 nimbipennis Alex., 407, 408.
 Trypauchen vagina Bl. & Schn., 298.
 wakæ Jordan and Snyder, 298.
 Trypauchenidæ, 298.
 Tuna fishing in Southern Mindanao, 423.
 Tuna, striped, 423; yellowfin, 423.

U

- Umbraculum Rumpf., 47.
 corniculatum Kze., 47.
 corniculatum (Linn.) Kze., 47.
 Upo, 318.

V

- Vaccinium laetum Diels, 46.
 Vandenboschia, 465.
 angustata (Carm.) Copel., 466.
 latifrons, 465.
 schmidiana (Zenker) Copel., 465.
 tenera Copel., 466.
 Vaimosa Jordan and Seale, 305.
 Vestiplex, 394.
 Vinta, 339.

W

- WALKER, EGBERT H., A revision of the eastern Asiatic Myrsinaceæ, 1.
 WEST, AUGUSTUS P., see TANCHICO and WEST.
 White squash, 318.

X

- Xylocarpus granatum, 323, 326.

Y

- Yellowfin tuna, 423.

Z

- ZIMMERMAN, ELWOOD C. A new Philippine cucurbit-boring barid (Coleoptera, Curculionidæ), 213.

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CONTENTS

Nos. 1-2, September-October, 1940

[Issued December 18, 1940]

	Page
WALKER, EGBERT H. A revision of the eastern Asiatic Myrsinaceae Thirty-seven text figures.	1

No. 3, November, 1940

[Issued December 23, 1940]

TANCHICO, S. S., and AUGUSTUS P. WEST. Analysis and composition of Manila copal	259
Three plates and three text figures.	
TANCHICO, S. S., and AUGUSTUS P. WEST. The refining of Manila copal	285
One plate and two text figures.	
HERRE, ALBERT W. C. T. Notes on fishes in the Zoölogical Museum of Stanford University, VIII: A new genus and two new species of Chinese gobies with remarks on some other species....	293
One plate.	
ROXAS, HILARIO A. New Philippine gobioid fishes	301
Eight plates.	
ZIMMERMAN, ELWOOD C. A new Philippine cucurbit-boring barid (Coleoptera, Curculionidæ)	313
One text figure.	
RASALAN, SANTOS B. Preservation of fishing gear in Samar Prov- ince, Philippines	321
One plate and two text figures.	
DOMANTAY, JOSE S. The catching of live bait for tuna fishing in Mindanao	337
Four plates and two text figures.	
COPELAND, EDWIN BINGHAM. Oleandrid ferns (Davalliaceæ) of New Guinea	345
Ten plates.	
BOOKS	359

No. 4, December, 1940

[Issued January 2, 1941]

ALEXANDER, CHARLES P. New or little-known Tipulidæ from eastern Asia (Diptera) XLIII	375
Five plates.	
PIC, M. Coléoptères malacodermes nouveaux	421
DOMANTAY, JOSE S. Tuna fishing in southern Mindanao	423

	Page
ARRIOLA, FELIX J. A preliminary study of the life history of <i>Scylla serrata</i> (Forskål)	437
Three plates and one text figure.	
COPELAND, EDWIN BINGHAM. Notes on Hymenophyllaceæ	457
Four plates.	
BOOKS	471
INDEX	485

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CONTENTS

	Page
ALEXANDER, CHARLES P. New or little-known Tipulidæ from eastern Asia (Diptera), XLIII	375
PIC, M. Coléoptères Malacodermes nouveaux.....	421
DOMANTAY, JOSE S. Tuna fishing in southern Mindanao	423
ARRIOLA, FELIX J. A preliminary study of the life history of Scylla serrata (Forskål)	437
COPELAND, EDWIN BINGHAM. Notes on Hymenophyllaceæ	457
BOOKS	471
INDEX	485

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